NATIONAL INSTITUTE FOR HEALTH AND CARE EXCELLENCE

INTERVENTIONAL PROCEDURES PROGRAMME

Interventional procedure overview of transvaginal laser therapy for stress urinary incontinence

Stress urinary incontinence causes urine to leak when you exercise, cough, laugh or sneeze. In this procedure, a device containing a laser is inserted into the vagina (transvaginal). The laser heats the vaginal tissue, causing changes to its structure. It is thought that this could improve support to the bladder. The aim is to reduce the symptoms of stress urinary incontinence.

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Introduction

The National Institute for Health and Care Excellence (NICE) prepared this interventional procedure overview to help members of the interventional procedures advisory committee (IPAC) make recommendations about the safety and efficacy of an interventional procedure. It is based on a rapid review of the medical literature and professional opinion. It should not be regarded as a definitive assessment of the procedure.

Date prepared

This overview was prepared in July 2020.

Procedure name

- Transvaginal laser therapy for stress urinary incontinence

Professional societies

- British Society of Urogynaecology
- British Association of Urological Surgeons
- Royal College of Obstetrics and Gynaecology.

Description of the procedure

Indications and current treatment

Stress urinary incontinence is the involuntary leakage of urine during exercise or certain movements such as coughing, sneezing and laughing. In women, it is most commonly associated with previous pregnancy, with or without recognised obstetric trauma. Previous urogynaecological surgery may also result in stress urinary incontinence.

NICE's guideline on urinary incontinence and pelvic organ prolapse describes recommendations for the management of urinary incontinence in women, accompanied by a patient decision aid to promote shared decision making. Conventional treatment is conservative and includes lifestyle changes such as weight loss and pelvic floor muscle training. Surgical options are only offered if conservative measures do not help.

What the procedure involves

Transvaginal laser therapy for stress urinary incontinence is done as an outpatient procedure and can be done without anaesthetic. A laser-probe device is inserted into the vagina to apply laser energy to the vaginal wall. The laser causes a controlled thermal injury, which is claimed to promote tissue remodelling and the production of new collagen. Treatment typically consists of 3 sessions at 4 to 6 weeks apart. The aim is to improve the support to the bladder and reduce the symptoms of stress urinary incontinence.

There are different types of lasers used for this procedure, including CO_2 and erbium-doped yttrium aluminium garnet (Er:YAG) lasers. The type of laser and the energy level used have different tissue penetration and can cause different types of thermal injury.

Outcome measures

International Consultation on Incontinence Questionnaire-Urinary Incontinence Short Form (ICIQ-UI SF)

The ICIQ-UI SF is a questionnaire for evaluating the frequency, severity and impact on quality of life of urinary incontinence in men and women. It has 4 items (frequency or urinary incontinence, amount of leakage, overall impact of urinary incontinence and a self-diagnostic item), with a total score ranging from 0 to 21. The score is divided into severity categories of slight (1 to 5), moderate (6 to 12), severe (13 to 18) and very severe (19 to 21).

Efficacy summary

ICIQ-UI SF scores

In a randomised controlled trial (RCT) of 114 premenopausal women with stress urinary incontinence, the ICIQ-UI SF score changed by -3.86 points (95% confidence interval [CI] -5.06 to -2.66, p<0.001) in the laser group and - 1.05 points (95% CI -2.01 to -0.09, p=0.032) in the sham group (p<0.001 between groups) at 3-month follow up. A statistically significantly higher proportion of patients were dry (ICIQ-UI SF score 0) in the laser group (21% [12/56]) compared with the sham group (4% [2/56]; p=0.006; risk ratio 6.0, 95% CI 1.4 to 25.6). Of the 12 patients who had laser treatment and who were dry at 3-month follow up, 11 had slight to moderate symptoms at baseline and 1 had severe symptoms.[1]

In an RCT of 72 postmenopausal women with urinary symptoms, comparing laser therapy with topical oestrogen and vaginal lubricant, the frequency of urine

loss score was statistically significantly reduced in the laser group from 2.08 at baseline to 1.36 at week 14 (p=0.021). There was no reduction in the other 2 treatment groups (p=0.035 between groups). The total ICIQ-UI SF scores at week 14 were 6.45 in the laser group, 7.79 in the topical oestrogen group and 11.47 in the vaginal lubricant group (p=0.028 between groups). The only statistically significant reduction from baseline was in the laser group (p=0.004).[2]

In a non-randomised comparative study of 150 women with stress urinary incontinence who had laser therapy, tension-free vaginal tape or transobturator tape the ICIQ-SF scores statistically significantly improved in all 3 groups after treatment (p<0.001). The approximate values (estimated from graphical presentation) were 12.5 at baseline compared with 2 after treatment, for all 3 groups. The proportion of patients with no urine loss after the procedure was 50%, 69% and 68% respectively.[3]

In a case series of 161 postmenopausal women with stress urinary incontinence associated with genitourinary syndrome of menopause, the ICIQ-UI SF scores reduced from 14.34 at baseline to 7.09, 7.49 and 6.76 at 12, 24 and 36-month follow up respectively (p<0.001 for all time periods). At the end of treatment, 32% (51/161) of patients reported having moderate urinary incontinence.[4]

In a case series of 114 postmenopausal women with stress urinary incontinence associated with genitourinary syndrome of menopause, the ICIQ-UI SF scores reduced from 12.2 at baseline to 4.8, 6.2, 7.0, 8.0, 9.3 and 9.9 at 1, 3, 6, 12, 18 and 24 months after the last treatment (p<0.01 up to 12 months).[6]

In a case series of 82 women with stress urinary incontinence or mixed urinary incontinence, the ICIQ-UI SF score reduced from 13.60 at baseline to 7.17 at follow up (mean follow-up of 22 months; p<0.001). Mild, moderate or high improvement was reported in 79% (33/42) of patients with stress urinary incontinence and 68% (27/40) of patients with mixed urinary incontinence. The mean improvement was statistically significantly greater in the stress urinary incontinence group (p=0.008).[7]

In a case series of 59 women with stress urinary incontinence, subjective cure rates based on ICIQ-UI SF scores were 72% (23/32) at 6 months and 66% (21/32) at 2 years after the last laser session for patients with grade 1 stress urinary incontinence. No patients with grade 2 or 3 stress urinary incontinence were classified as cured at 6 months, and 13% (2/16) of patients with grade 2 and no patients with grade 3 stress urinary incontinence were classified as cured at 2 years.[8]

1-hour pad test

In the non-randomised comparative study of 150 patients who had laser therapy, tension-free vaginal tape (TVT) or transobturator tape (TOT), the mean values of the 1-hour pad test statistically significantly improved in all 3 groups ($p<0.001$) after treatment. Approximate values (estimated from graphical presentation) were 34 g, 38 g and 37 g for laser, TVT and TOT respectively at baseline, compared with 2 g, 3 g and 4 g after treatment.[3]

In the case series of 161 patients, the 1-hour pad weight reduced from 9.89 g at baseline to 3.52 g, 3.55 g and 3.72 g at 12, 24 and 36 months respectively ($p<0.001$ for all time periods).[4]

In the case series of 59 women, objective cure or improvement rates based on the 1-hour pad test were 91% (29/32) at 6 months and 78% (25/32) at 2 years after the last laser session for patients with grade 1 stress urinary incontinence. For patients with grade 2 stress urinary incontinence, the rates were 69% (11/16) at 6 months and 50% (8/16) at 2 years after the last laser session. No patients with grade 3 stress urinary incontinence had objective cure or improvement at 6 months or 2 years after the laser session.[8]

Incontinence severity index

In a case series of 175 patients with stress urinary incontinence or mixed urinary incontinence, symptoms significantly improved at 1-year follow up in 77% (88/114) of patients with stress urinary incontinence and 34% (20/61) of patients with mixed urinary incontinence ($p<0.001$ between the 2 groups). The grade of urinary incontinence at 1-year follow up was none for 62% (108/175) of patients, mild for 25% (43/175), moderate for 12% (21/175), severe for 2% (3/175) and very severe for no patients. At baseline, 17% (30/175) of patients had mild urinary incontinence, 27% (47/175) had moderate, 51% (89/175) had severe and 5% (9/175) had very severe incontinence.[5]

Safety summary

Fistula

Vesicovaginal fistula was described as the ‘most possible’ diagnosis in 1 patient who had laser treatment for stress urinary incontinence. The patient had total urinary incontinence after the procedure. A foley catheter was inserted for bladder drainage for 2 weeks, after which the urine leakage resolved.[11]

Vaginal mucosa scarring

Vaginal mucosa scarring was described in 1 patient who had laser treatment for feelings of vaginal laxity during intercourse, vaginal wind, vaginal bulge and stress urinary incontinence. She had stage 2 POP-Q posterior prolapse, stage 2 anterior prolapse and a positive cough stress test. One year after the laser treatment, she had a posterior vaginal repair and retropubic mid-urethral tension-free vaginal tape. During the procedure, the vaginal mucosa was found to be very thin, friable, with loss of rugae, which made the procedure difficult. There was slightly higher blood loss than usual during the procedure. Postoperatively, the patient recovered well with no prolapse or incontinence symptoms and the vaginal mucosa had healed well at 5-week follow up.[10]

Vaginal discharge

Increased vaginal discharge lasting up to 3 weeks was reported by 88% (49/56) of patients who had laser treatment and 11% (6/56) of patients who had sham treatment in the RCT of 114 patients.[1] Vaginal discharge was reported in 1 patient in the case series of 59 patients.[8]

De novo urge urinary incontinence

De novo urgency that resolved within a few days was reported in 4% (2/56) of patients who had laser treatment in the RCT of 114 patients.[1] De novo urge urinary incontinence was reported by 4% (7/163) of patients after a second laser treatment in the case series of 175 patients. Worsening of urinary incontinence (in terms of urge urinary incontinence) was reported in 22% (38/175) of patients.[5]

Vaginal dryness

Increased vaginal dryness was reported by 1 patient who had laser treatment in the RCT of 114 patients.[1]

Adverse events reported to the US Food and Drug Administration

Adverse events relating to laser and energy-based devices for vaginal rejuvenation were reported on the Food and Drug Administration MAUDE database for 45 patients (including 6 procedures to treat urinary incontinence): pain (n=19), burning or numbness (n=11), scarring or burns (n=7), dyspareunia (n=6), increased urinary frequency or incontinence (n=4), redness or irritation (n=3), infection (n=2), bladder or urethral pain (n=2), discomfort (n=2), miscellaneous (n=3).[9]

Anecdotal and theoretical adverse events

In addition to safety outcomes reported in the literature, professional experts are asked about anecdotal adverse events (events which they have heard about) and about theoretical adverse events (events which they think might possibly occur, even if they have never happened). For this procedure, professional experts did not describe any additional anecdotal or theoretical adverse events.

The evidence assessed

Rapid review of literature

The medical literature was searched to identify studies and reviews relevant to transvaginal laser therapy for stress urinary incontinence. The following databases were searched, covering the period from their start to 20 July 2020: MEDLINE, PREMEDLINE, EMBASE, Cochrane Library and other databases. Trial registries and the Internet were also searched. No language restriction was applied to the searches (see the literature search strategy). Relevant published studies identified during consultation or resolution that are published after this date may also be considered for inclusion.

The following selection criteria (table 1) were applied to the abstracts identified by the literature search. Where selection criteria could not be determined from the abstracts the full paper was retrieved.

Table 1 Inclusion criteria for identification of relevant studies

Characteristic	Criteria
Publication type	Clinical studies were included. Emphasis was placed on identifying good quality studies. Abstracts were excluded where no clinical outcomes were reported, or where the paper was a review, editorial, or a laboratory or animal study. Conference abstracts were also excluded because of the difficulty of appraising study methodology, unless they reported specific adverse events that were not available in the published literature.
Patient	Patients with stress urinary incontinence.
Intervention/test	Transvaginal laser therapy.
Outcome	Articles were retrieved if the abstract contained information relevant to the safety and/or efficacy.
Language	Non-English-language articles were excluded unless they were thought to add substantively to the English-language evidence base.

List of studies included in the IP overview

This IP overview is based on 976 patients from 2 randomised controlled trials, 1 non-randomised comparative study, 6 case series and 2 case reports.[1 to 11]

Other studies that were considered to be relevant to the procedure but were not included in the main extraction table (table 2) are listed in the appendix.

Table 2 Summary of key efficacy and safety findings on transvaginal laser therapy for stress urinary incontinence

Study 1 Blaganje M (2018)

Details

Study type	**Randomised controlled trial**
Country	Slovenia
Recruitment period	2012 to 2013
Study population and number	**n=114 (57 laser therapy, 57 sham)** Premenopausal parous women with stress urinary incontinence
Age	Mean: 40 years (laser); 42 years (sham)
Patient selection criteria	Inclusion criteria: premenopausal (age range 35 to 65 years), sexually active women with at least 1 vaginal delivery and a diagnosis of stress urinary incontinence. Clinical examination, a cough test (stress test), a Q-tip test, and urodynamic analysis were done during initial consultation. Exclusion criteria: pelvic organ prolapse greater than stage 1 (according to POP-Q classification), inability to do correct pelvic floor muscle (PFM) contraction, urgency or mixed urinary incontinence, infection, and previous gynaecological surgery or irradiation. Correct PFM contraction was assessed with a 1 finger vaginal palpation by trained and certified physiotherapists specialised in rehabilitation of pelvic floor defects.
Technique	All patients had a single session with non-ablative 2940 nm Er:YAG laser (XS Dynamis, Fotona, Slovenia). Patients in the laser group were treated according to the manufacturer's Incontilase protocol. Patients in the sham group had the same procedure but with zero intensity settings. The introitus was anaesthetised with lidocaine spray before the laser treatment. The anterior vaginal wall was treated first. Four laser pulses were deposited at every 5 mm along the total length of the vagina in 5 passes. The whole vaginal canal was then irradiated in 3 passes. Finally, the speculum was removed and the mucosa of the vestibule and the introitus was irradiated. Patients were not taught, encouraged or discouraged to do PFM training during the study period. Patients were advised to avoid increased intra-abdominal pressure and sexual intercourse for 3 days after the procedure.
Follow-up	**3 months**
Conflict of interest/source of funding	Not reported

Analysis

Follow-up issues: two patients were lost to follow-up (1 in each group).

Study design issues: Randomised controlled trial comparing active laser therapy with sham. Randomisation was done using sealed envelopes. Patients and staff doing the outcome measurements were blinded to the treatment allocation. The primary outcome measure was a validated Slovenian translation of the International Consultation on Incontinence Questionnaire – Urinary Incontinence Short Form (ICIQ-UI SF). Sexual function was assessed with 2 validated questionnaires: the Pelvic Organ Prolapse Urinary Incontinence Sexual Questionnaire (PISQ-12; maximal score 48) and the Female Sexual Function Index (FSFI; range 2 to 36, with a score of 26 or less suggestive of female sexual dysfunction). A sample size of 54 patients per group was calculated to give 90% power, with an expected cure rate of 5% in the sham group and 30% in the laser group at 3 month follow up.

Study population issues: The mean baseline ICIQ-UI SF score was 12.00 in the laser group and 12.41 in the sham group. Mean muscle stamina was 8 seconds in the laser group and 7 seconds in the sham group and average contraction pressure was 20.9 and 18.0 hPa respectively (p values not reported).

Key efficacy and safety findings

Efficacy

Number of patients analysed: **112 (56 laser, 56 sham)**

Outcome measures at 3-month follow-up

Outcome measure	Laser			Sham			Laser compared with sham		
	Change	95% CI	p	Change	95% CI	p	change	95% CI	p
ICIQ-UI SF	-3.86	-5.06 to -2.66	<0.001	-1.05	-2.01 to -0.09	0.032	-2.86	-4.34 to -1.35	<0.001
≤12 (slight to moderate SUI at baseline)	-3.96	-5.37 to -2.56	<0.001	-0.45	-2.08 to 1.18	0.481	-3.66	-5.78 to -1.55	0.001
>12 (severe SUI at baseline)	-3.76	-5.38 to -2.13	<0.001	-1.39	-2.85 to 0.69	0.042	-1.93	-4.20 to 0.34	0.094
PISQ-12	3.00	1.81 to 4.19	<0.001	0.89	-0.27 to 2.06	0.129	1.87	0.38 to 3.37	0.014
FSFI*	3.06	1.96 to 4.16	<0.001	1.35	0.48 to 2.22	0.003	1.52	0.19 to 2.86	0.025
Duration	1.04	0.50 to 1.57	<0.001	0.45	-0.15 to 1.05	0.141	0.98	0.30 to 1.66	0.005
Max pressure	5.60	2.25 to 8.95	0.001	1.89	-1.74 to 5.51	0.302	4.68	0.01 to 9.35	0.05
Average pressure	4.24	1.72 to 6.75	0.001	1.64	-0.60 to 3.89	0.148	3.03	-0.28 to 6.35	0.072

* only the subset of patients who were sufficiently sexually active at both assessment times were analysed (n=54 in the laser group and n=52 in the sham group)

Proportion of patients who were dry (ICIQ-UI SF score=0) at 3-month follow-up

- laser=21.4% (12/56) (11 patients had slight to moderate symptoms at baseline and 1 had severe symptoms)
- sham=3.6% (2/56), p=0.006

Risk ratio=6.00, 95% CI 1.41 to 25.59

Safety

There were no serious adverse events.

Increased vaginal discharge lasting up to 3 weeks was reported by 87.5% (49/56) of patients in the laser group and 10.7% (6/56) of patients in the sham group.

2 patients in the laser group had de novo urgency that resolved within a few days.

1 patient in the laser group had increased vaginal dryness after the procedure.

Tolerability was good or better than good for 80% (45/56) of patients in the laser group and 91% (51/56) of patients in the sham group.

Abbreviations used: CI, confidence interval; FSFI, Female Sexual Function Index; ICIQ-UI SF, International Consultation on Incontinence Questionnaire – Urinary Incontinence Short Form; PISQ-12, Pelvic Organ Prolapse Urinary Incontinence Sexual Questionnaire; SUI, stress urinary incontinence

Study 2 Aguiar L (2020)

Details

Study type	**Randomised controlled trial**
Country	Brazil
Recruitment period	2017 to 2018
Study population and number	**n=72 (24 laser therapy, 24 topical oestrogen, 24 vaginal lubricant)** Postmenopausal women with urinary symptoms
Age	Mean 57 years
Patient selection criteria	Inclusion criteria: women aged 50 years or older who were amenorrhoeic for at least 1 year, with clinical complaints of vaginal dryness or urinary symptoms related to genitourinary syndrome of menopause, and who did not use hormonal treatment for at least 6 months before the study or any kind of medication for overactive bladder. Exclusion criteria: declined to participate, absolute or relative contraindications to topical oestrogen, positive HIV serology, genital condylomatosis, previous pelvic radiotherapy, surgery in the anterior, middle or posterior compartment of the vagina.
Technique	Laser therapy was done using a fractional CO_2 laser (Monalisa Touch, Deka, Italy). Three treatments were scheduled 30 to 45 days apart. No anaesthesia was used. Patients were instructed not to go to beaches or swimming pools and to abstain from sexual intercourse for 10 days after the treatment. Patients in the topical oestrogen group self-administered vaginal promestriene 3 times weekly for 12 weeks. Patients in the vaginal lubricant group used topical lubricant gel applied with sexual activity over a period of 12 weeks. The patients did not do pelvic floor physical therapy.
Follow-up	**2 weeks after the end of treatment**
Conflict of interest/source of funding	Not reported

Analysis

Follow-up issues: Of the 72 patients, 14 (19%) were lost to follow-up: 2 were in the laser group, 5 were in the topical oestrogen group and 7 were in the vaginal lubricant group. One patient discontinued the use of the vaginal lubricant because of allergic vaginitis in week 4.

Study design issues: Randomised controlled trial. Patients were randomised into 3 groups using computerised randomisation. The main outcome measures were the ICIQ-UI SF and ICIQ-OAB scores. Secondary outcomes were the urinary symptoms related to genitourinary syndrome of menopause before and after treatment. Intention to treat analysis was done, with the last observation being carried forward in cases of missing follow-up data. A sample size of at least 20 patients was calculated based on the changes in Vaginal Health Index scores after laser treatment.

Study population issues: There were no statistically significant differences in clinical and sociodemographic characteristics between the groups apart from a lower proportion of non-Caucasians in the laser group (p=0.043). Of the 72 patients, 58 (81%) had stress urinary incontinence at baseline; 59 (82%) patients had urge incontinence, 45 (63%) had urgency, 35 (49%) had nocturia, and 28 (39%) had increased urinary frequency.

Key efficacy and safety findings

Efficacy

Number of patients analysed: **72 (24 laser therapy, 24 topical oestrogen, 24 vaginal lubricant)**

ICIQ-UI SF scores at baseline and week 14 (mean ± SD)

	Laser therapy	Topical oestrogen	Vaginal lubricant	p
Frequency of urinary loss				
Baseline	2.08 (1.61)	1.88 (1.51)	2.33 (1.52)	0.574
Week 14	1.36 (1.33)	1.95 (1.39)	2.71 (1.72)	**0.035**
p	**0.021**	0.811	0.888	
Difference	-0.86 (1.64)	0.11 (1.29)	-0.06 (1.52)	0.206
Amount of urine lost				
Baseline	2.08 (1.50)	2.33 (1.83)	2.17 (1.31)	0.923
Week 14	1.64 (1.18)	1.89 (1.05)	2.47 (1.50)	0.162
p	0.148	0.188	1.00	
Difference	-0.55 (1.41)	-0.53 (1.31)	0.00 (1.22)	0.415
Interference of urinary loss in daily life				
Baseline	4.75 (3.90)	4.71 (4.37)	5.33 (3.66)	0.746
Week 14	3.45 (3.02)	3.95 (3.57)	6.29 (3.42)	**0.043**
p	**0.02**	0.266	0.661	
difference	-1.73 (3.06)	-1.11 (3.97)	-0.12 (1.87)	0.374
Total score				
Baseline	8.92 (6.55)	8.92 (7.11)	9.89 (5.90)	0.834
Week 14	6.45 (4.67)	7.79 (5.24)	11.47 (5.95)	**0.028**
p	**0.004**	0.235	0.812	
Difference	-3.14 (5.12)	-1.53 (5.82)	-0.18 (2.60)	0.174
p*	**0.012**			0.116**

* p value for the ANOVA test for repeated measures intragroup total score

** p value for the ANOVA test for repeated measures intergroup total score

ICIQ-OAB scores at baseline and week 14 (mean ± SD)

	Laser therapy	Topical oestrogen	Vaginal lubricant	P
Urinary frequency				
Baseline	0.88 (1.03)	1.46 (1.50)	1.46 (1.38)	0.303
Week 14	1.00 (1.27)	1.11 (1.10)	1.12 (1.27)	0.837
p	0.942	0.463	0.949	
Difference	0.05 (1.25)	-0.21 (1.08)	-0.12 (1.45)	0.837
Nocturia				
Baseline	1.33 (0.87)	1.75 (1.11)	1.96 (1.08)	0.153
Week 14	1.00 (0.76)	1.42 (1.07)	2.18 (0.95)	**0.002**
p	0.031	0.148	0.641	
Difference	-0.41 (0.73)	-0.32 (0.75)	0.18 (1.01)	**0.004**

Safety

There were no complications or short-term adverse effects in the laser therapy group.

Urgency				
Baseline	1.54 (1.32)	1.92 (1.28)	2.13 (1.12)	0.267
Week 14	1.41 (1.10)	1.58 (0.90)	2.24 (1.20)	0.069
p	0.440	0.283	1.00	
difference	-0.23 (1.19)	-0.37 (1.26)	-0.12 (1.32)	0.533
Urge incontinence				
Baseline	1.46 (1.28)	1.63 (1.17)	2.13 (1.15)	0.126
Week 14	1.23 (0.92)	1.32 (1.00)	2.24 (1.09)	**0.01**
p	0.180	0.435	0.750	
Difference	-0.32 (0.89)	-0.26 (1.15)	-0.12 (0.70)	0.800
Total score				
Baseline	5.21 (3.66)	6.75 (4.42)	7.67 (3.61)	0.086
Week 14	4.64 (2.59)	5.42 (3.02)	7.76 (3.36)	**0.02**
p	0.204	0.091	0.633	
Difference	-0.91 (2.89)	-1.16 (3.15)	-0.18 (3.03)	0.174
p*				**0.038**

* p value for the ANOVA test for repeated measures total score intergroup (laser over lubricant)

Abbreviations used: ICIQ-UI SF, International Consultation on Incontinence Questionnaire-Urinary Incontinence Short Form; ICIQ-OAB, International Consultation on Incontinence Questionnaire-Overactive bladder; SD, standard deviation

Study 3 Okui N (2019)

Details

Study type	**Non-randomised comparative study**
Country	Japan
Recruitment period	2014 to 2016
Study population and number	**n=150 (50 laser therapy, 50 tension-free vaginal tape [TVT], 50 transobturator tape [TOT])** Women with stress urinary incontinence
Age	• Laser therapy: 50.3±13.2 years • TVT: 48.7±13.9 years • TOT: 47.8±13.9 years
Patient selection criteria	Women aged 20 to 65 years with stress urinary incontinence, with no objective evidence of cardiovascular disease (according to American Heart Association criteria). Exclusion criteria: history of surgery for incontinence or a history of treatment with drugs for incontinence, overactive bladder, neurogenic bladder dysfunction, oestrogen therapy, cystocele, uterine prolapse, rectocele, neuropathy such as spinal stenosis. If urge incontinence was affecting daily life more than stress urinary incontinence, drugs were offered during the preoperative observation period and the patient was excluded from the study. Women who were pregnant, breastfeeding, or who wanted to become pregnant were excluded.
Technique	Laser therapy was done using an Er:YAG laser (FotonaSmooth XS, Fotona, Slovenia). Xylocaine was sprayed into the vagina before the laser probe was inserted. The wavelength was set to 2940 nm and irradiation was done for 20 minutes: the first 10 minutes on the entire anterior wall of the vagina, 5 minutes on the entire vagina and 5 minutes around the urethra. Laser irradiation was done 3 times every alternate month. The TVT procedure was done under lumbar anaesthesia using the Advantage Fit Transvaginal Mid-Urethral Sling System (Boston Scientific) or GYNECARE TVT Retropubic System (Ethicon Inc.). The TOT procedure was done under lumbar anaesthesia using the Monarc transobturator sling system or the Obtryx II Transobturator Mid-Urethral Sling System. All procedures were done by the same surgeon.
Follow-up	**12 months**
Conflict of interest/source of funding	None

Analysis

Follow-up issues: no losses to follow-up were described.

Study design issues: Prospective non-randomised comparative study. Patients had laser therapy in 2016, a TOT procedure in 2015 or a TVT procedure in 2014, and were selected in numerical order of their medical charts. Outcomes were measured using a 1-hour pad test, the ICIQ-SF and overactive bladder symptom score (OABSS). Question 4 of the OABSS is on urge incontinence and was considered important for the evaluation of mixed urinary incontinence (scale 0 to 5 with 0 being no incontinence, 1 and 2 mild incontinence, 3 and 4 moderate incontinence and 5 being severe incontinence).

Study population issues: the paper states that there were no significant differences between the groups in baseline 1-hour pad test and ICIQ-SF scores, but they were not reported. Patients in the TVT and TOT groups who had intense urinary urgency declined surgery and were started on overactive bladder pharmacotherapy first, which caused variations in the OABSS scores between the groups.

Key efficacy and safety findings

<table>
<tr><th>Efficacy</th><th>Safety</th></tr>
<tr><td>
Number of patients analysed: 150 (50 laser, 50 TVT, 50 TOT)

Percentage of patients with no urine loss
• Laser=50% (no residual urine was observed)
• TVT=69% (residual urine was present in 10 patients, mean volume 10.1 ml)
• TOT=68% (residual urine was present in 7 patients, mean volume 10.4 ml)

Postoperative incontinence of 10 g or more
• Laser, n=1
• TVT, n=4
• TOT, n=4

1-hour pad test
The mean values of the 1-hour pad test statistically significantly improved in all 3 groups (p<0.001) after treatment. Approximate values (estimated from graphical presentation) were 34 g, 38 g and 37 g for laser, TVT and TOT at baseline, compared with 2 g, 3 g and 4 g, respectively after treatment.

ICIQ-SF
The mean values of the ICIQ-SF statistically significantly improved in all 3 groups (p<0.001) after treatment. Approximate values (estimated from graphical presentation) were 12.5 at baseline, compared with 2 after treatment for all 3 groups.

Great dissatisfaction was expressed by no patients in the laser group, 3 patients in the TVT group and 3 patients in the TOT group.

OABSS
Only patients in the laser group had a statistically significant improvement (p<0.001, from approximately 2.8 at baseline to 0.2 after treatment).
In the TVT group, the score was approximately 2.0 at baseline and 2.2 after treatment. In the TOT group, the score was approximately 1.6 at baseline and 1.8 after treatment.

Number of patients with a score of 4 for question 4 of the OABSS
<table>
<tr><th>Intervention</th><th>Baseline</th><th>12 months after treatment</th></tr>
<tr><td>Laser therapy</td><td>2</td><td>0</td></tr>
<tr><td>TVT</td><td>2</td><td>3</td></tr>
<tr><td>TOT</td><td>0</td><td>2</td></tr>
</table>
</td><td>
Short-term complications in the TVT group included severe pain in 1 patient and infection in 2 patients.

In the TOT group, 1 patient had severe femoral pain and 1 patient had infection.
Long-term adverse effects after 12 months included persistent femoral pain in 1 patient in the TOT group.

No adverse effects were observed in the laser therapy group.
</td></tr>
<tr><td colspan="2">Abbreviations used: ICIQ-SF, International Consultation on Incontinence Questionnaire-Short Form; OABSS, overactive bladder symptom score; TOT, transobturator tape; TVT, tension-free vaginal tape</td></tr>
</table>

Study 4 Gonzalez Isaza P (2018)

Details

Study type	**Case series**
Country	Colombia
Recruitment period	2015
Study population and number	**n=161** Postmenopausal women with stress urinary incontinence associated with genitourinary syndrome of menopause
Age	Mean 53 years (range 45 to 65)
Patient selection criteria	Postmenopausal women with a diagnosis of mild stress urinary incontinence were included. Exclusion criteria: patients with genital prolapse of POP-Q stage greater than 1 in the anterior compartment and patients who were not adequately classified because of previous surgery, recurrent lower urinary tract infection or obesity (body mass index greater than 35 kg/m^2).
Technique	Device: Fractional CO_2 laser system (MonaLisa Touch, Deka, Italy). The laser was applied at the urethrovesical junction and punch biopsies were obtained before and after treatment. Laser treatment comprised 4 sessions every 30 to 45 days followed by a yearly treatment session at 12, 24 and 36 months.
Follow-up	**36 months**
Conflict of interest/source of funding	None

Analysis

Follow-up issues: no losses to follow-up were described.

Study design issues: Prospective, single centre case series. Stress urinary incontinence was evaluated using the ICIQ-UI SF and the International Continence Society 1-hour pad test before and after each treatment.

Study population issues: Of the 161 women, 40 (37%) were using hormone replacement therapy at baseline.

Key efficacy and safety findings

Efficacy	Safety
Number of patients analysed: **161** **ICIQ-UI SF scores** • Baseline=14.34±2.65 • 12 months=7.09±1.1 • 24 months=7.49±0.94 • 36 months=6.76±0.82 p<0.001 compared with baseline for all time periods At the end of treatment, 32% (51/161) of patients reported having moderate urinary incontinence. **1-hour pad weight test (g)** • Baseline=9.89±0.57 • 12 months=3.52±1.89 • 24 months=3.55±1.88 • 36 months=3.72±2.05 p<0.001 compared with baseline for all time periods Histological examination of the vaginal mucosa revealed thicker epithelium with a higher population of intermediate and shedding superficial cells and underlying connective tissue with papillae indenting the epithelium-connective tissue junction.	'The treatment was well tolerated, and no side effects were observed during the study period.'
Abbreviations used: ICIQ-UI SF, International Consultation on Incontinence Questionnaire-Urinary Incontinence Short Form	

Study 5 Ogrinc U (2015)

Details

Study type	**Case series**
Country	Slovenia
Recruitment period	2012 to 2013
Study population and number	**n=175** Women with stress urinary incontinence or mixed urinary incontinence
Age	Mean 50 years
Patient selection criteria	Inclusion criteria: clinically confirmed urinary incontinence, normal PAP smear, negative urine culture, and integrity of the vaginal mucosa (without injuries or bleeding). Exclusion criteria: pregnancy, intake of photosensitive drugs, injuries or vaginal bleeding, infection in the treated area, pure urge urinary incontinence.
Technique	Device: non-ablative 2940 nm Er:YAG laser (SP Spectro, Fotona, Slovenia). No anaesthesia was used. Each laser treatment consisted of 3 phases. In the first phase, the full circumference of the vaginal canal is irradiated. In the second phase, the anterior vaginal wall was irradiated. After the second phase was completed, the laser speculum was removed from the vaginal canal and laser energy was delivered to the mucosa of the vestibule and introitus. After 4 to 6 weeks, a second laser treatment was done, and a third procedure was usually done 6 months after the first procedure. Of the 175 patients, 12 (7%) had 1 procedure, 54 (31%) had 2 procedures and 109 (62%) had 3 procedures.
Follow-up	**12 months**
Conflict of interest/source of funding	None

Analysis

Follow-up issues: There were no losses to follow-up.

Study design issues: Prospective, single centre case series. Urinary incontinence was assessed before and after each treatment. The treatment outcome and degree of improvement were assessed by the ICIQ-SF and the incontinence severity index (categorised into 4 grades: mild, moderate, severe and very severe).

Study population issues: At baseline, 65% (114/175) of patients had stress urinary incontinence and 35% (61/175) had mixed urinary incontinence. The urinary incontinence was graded as mild in 17% (30/175) of patients, moderate in 27% (47/175), severe in 51% (89/175) and very severe in 5% (9/175) of patients.

Key efficacy and safety findings

Efficacy	Safety
Number of patients analysed: **175** **Grade of urinary incontinence at 1-year follow-up** • None=61.7% (108/175) (mean 2.54 procedures) • Mild=24.6% (43/175) (mean 2.6 procedures) • Moderate=12.0% (21/175) (mean 2.48 procedures) • Severe=1.7% (3/175) (3 procedures each) • Very severe=0% (0/175) **Decrease in incontinence severity index at 1-year follow-up by grade of urinary incontinence** • Mild=2.6±1.0 • Moderate=3.6±1.4 • Severe=5.7±1.8 • Very severe=8.4±2.6, p<0.001 There were no statistically significant differences with regard to age group. At 1-year follow-up, symptoms significantly improved in 77% (88/114) patients with stress urinary incontinence and 34% (20/61) of patients with mixed urinary incontinence (p<0.001 between the 2 groups). There were statistically significant differences between the first and second follow-up in all groups (regarding the grade of urinary incontinence) but not between the second and last follow-up.	There were no major adverse effects. During the procedure, patients had no pain or only mild discomfort (mean visual analogue scale [range 0 to 10] score = 0.5). Transient urge urinary incontinence after the first procedure was reported in 11 patients who had stress urinary incontinence. De novo urge urinary incontinence was reported in 4% (7/163) of patients after the second procedure. Worsening of urinary incontinence (in terms of urge urinary incontinence) was reported in 22% (38/175) of patients.

Study 6 Gambacciani M (2018)

Details

Study type	**Case series**
Country	Italy
Recruitment period	Not reported
Study population and number	**n=114** Postmenopausal women with genitourinary syndrome of menopause and stress urinary incontinence
Age	Mean 65 years
Patient selection criteria	Inclusion criteria for whole cohort: presence of genitourinary syndrome of menopause in women with plasma levels of gonadotropin and oestradiol in the postmenopausal range and negative Pap smear. Exclusion criteria: use of lubricants, local preparations, hormones or other medications to relieve menopausal symptoms in the previous 3 months before inclusion to the study; lesions, scars or infection, active or recent (30 days) of the genitourinary tract; abnormal uterine bleeding; history of photosensitivity disorder or use of photosensitising drugs; genital prolapse (grade 2 to 3 classification POP-Q); and serious or chronic illness that could interfere with the study.
Technique	Device: non-ablative 2940 nm Er:YAG laser (XS Fotona Smooth, Fotona, Slovenia). Patients had 3 treatment sessions at 30-day intervals. The procedures were done in an outpatient clinical setting without any preparation, anaesthesia or post-treatment medications. Before the procedure, the vagina was cleaned with disinfectant solution and dried with a swab. All patients had circular treatment of the vaginal wall followed by treatment of the vestibule and introitus. Patients with stress urinary incontinence had additional laser treatment of the anterior vaginal wall. After treatment, all patients were advised to abstain from sexual intercourse for 1 week.
Follow-up	**24 months**
Conflict of interest/source of funding	None

Analysis

Follow-up issues: the paper states that 23 (16.6%) patients were lost to follow-up, but it is unclear whether this refers to the whole cohort or just those women with stress urinary incontinence.

Study design issues: Prospective longitudinal single centre study. The aim of the study was to evaluate the long-term efficacy of vaginal laser treatment for the management of genitourinary syndrome of menopause. Stress urinary incontinence was assessed using the ICIQ-UI SF.

Other issues: The study included 235 women who had laser therapy for genitourinary syndrome of menopause, but only 114 of these had stress urinary incontinence. Of the 235 women who had treatment, 205 completed the study; 11 patients left the study for personal reasons, 13 because of other pharmacological or surgical interventions, and 1 patient who complained of discomfort after the first application.

Key efficacy and safety findings

Efficacy	Safety
Number of patients analysed: **114** **ICIQ-UI SF scores** • Baseline=12.2±2.5 • After first treatment=8.0±1.4* • After second treatment=4.7±1.8* • After third treatment=5.1±2.0* • 1 month after last treatment=4.8±1.8* • 3 months after last treatment=6.2±1.9* • 6 months after last treatment=7.0±2.3* • 12 months after last treatment=8.0±1.8* • 18 months after last treatment=9.3±2.7 • 24 months after last treatment=9.9±2.8 * p<0.01 compared with baseline The scores at 18 and 24 months were not statistically significantly different from baseline scores. 84.2% (96/114) of patients asked for a repeat procedure: 51 patients after 12 months, 30 after 18 months and 15 after 24 months. 7.9% (9/114) of patients were still satisfied after 24 months from the last laser treatment. 10 patients had surgery – it is unclear whether this is from the whole cohort or just those patients with stress urinary incontinence.	'No adverse events related to the procedure were recorded throughout the study period.'
Abbreviations used: ICIQ-UI SF, International Consultation on Incontinence Questionnaire-Urinary Incontinence Short Form	

Study 7 Erel C (2020)

Details

Study type	**Case series**
Country	Turkey
Recruitment period	2014 to 2018
Study population and number	**n=82** Women with urinary incontinence
Age	Mean 54 years (range 29 to 78)
Patient selection criteria	Women with urinary incontinence were included. A diagnosis of stress urinary incontinence or mixed urinary incontinence was established based on history, a pelvic examination and Q-tip test. A Q-tip test angle of more than 40° was accepted as a positive result for the diagnosis of stress urinary incontinence. All patients with mixed urinary incontinence had been using anti-muscarinic drugs for the urge component and had side-effects such as mouth dryness, difficulty in swallowing, aggravation of hypertension, palpitation, abdominal discomfort, nausea and bloating. Patients were asked to stop taking the medication at least 4 months before the laser treatment. Exclusion criteria: neurological disease, insulin-dependent diabetes mellitus, active urinary tract infection, haematuria, undiagnosed vaginal bleeding, cystocele more than grade 3 to 4.
Technique	Device: 2940 nm Er:YAG laser (SP Dynamis, Fotona, Slovenia). The technique used was based on the concept of pulse stacking of non-ablative, low-fluence laser pulses. In the first step, the circumference along the whole length of the vagina was irradiated. In the second step, the laser beam was directed to the anterior wall of the vagina. In the third step, peri-urethral and suburethral areas of the vaginal introitus were irradiated. The total number of passes was modified according to the patient's history (number of births, hysterectomy, TOT/TVT operations) and examination findings (severe vaginal atrophy, width and length of vagina).
Follow-up	**Mean 22 months (range 6 to 48)**
Conflict of interest/source of funding	None

Analysis

Follow-up issues: No losses to follow-up were described.

Study design issues: Prospective single centre cohort study. The objectives of the study were to determine the efficacy and predictive factors for the success of Er:YAG laser treatment in patients with urinary incontinence. Outcome measures were the ICIQ-UI SF and King's Health Questionnaire for Urinary Incontinence (KHQ-UI). The KHQ-UI questions were grouped into 7 sections: general health perceptions, role limitations, physical or social limitations, personal relationships, emotions, sleep or energy levels, and other issues reducing quality of life. The difference in ICIQ-UI SF results before the first procedure and after the final visit were used to determine the degree of improvement, which was categorised as none (0 to 25%), mild (26 to 50%), moderate (51 to 75%) or high (76 to 100%). Maximum improvement time was defined as the period up to the point when the effects of treatment started to decrease. Total improvement time was defined as the period up to the point when the treatment effect disappeared.

Study population issues: Of the 82 patients, 42 (51%) had stress urinary incontinence and 40 (49%) had mixed urinary incontinence; 54 patients were postmenopausal. The mean body mass index (BMI) at baseline was 26.4 kg/m^2 (range 18.9 to 40.1).

Key efficacy and safety findings

<table>
<tr><td>Efficacy</td><td>Safety</td></tr>
<tr><td>Number of patients analysed: 82

ICIQ-UI SF and KHQ-UI scores for each group of questions before and after the procedure, mean ± SD
<table>
<tr><td></td><td>Before</td><td>After</td><td>p value</td></tr>
<tr><td>ICIQ-UI SF</td><td></td><td></td><td></td></tr>
<tr><td>Frequency</td><td>3.62±1.18</td><td>1.99±1.70</td><td><0.001</td></tr>
<tr><td>Amount</td><td>4.01±1.64</td><td>2.09±1.71</td><td><0.001</td></tr>
<tr><td>VAS</td><td>6.29±2.25</td><td>3.20±2.89</td><td><0.001</td></tr>
<tr><td>Total</td><td>13.60±4.55</td><td>7.17±5.78</td><td><0.001</td></tr>
<tr><td>KHQ-UI</td><td></td><td></td><td></td></tr>
<tr><td>Group 1</td><td>4.76±1.60</td><td>3.00±1.59</td><td><0.001</td></tr>
<tr><td>Group 2</td><td>4.94±1.93</td><td>3.17±1.60</td><td><0.001</td></tr>
<tr><td>Group 3</td><td>10.80±4.00</td><td>6.94±3.73</td><td><0.001</td></tr>
<tr><td>Group 4</td><td>4.78±3.78</td><td>2.59±2.84</td><td><0.001</td></tr>
<tr><td>Group 5</td><td>8.65±3.05</td><td>5.52±3.05</td><td><0.001</td></tr>
<tr><td>Group 6</td><td>4.38±1.90</td><td>3.18±1.63</td><td><0.001</td></tr>
<tr><td>Group 7</td><td>10.18±3.43</td><td>6.72±3.23</td><td><0.001</td></tr>
<tr><td>Total</td><td>48.84±15.51</td><td>31.40±15.35</td><td><0.001</td></tr>
</table>
Difference in ICIQ-UI SF
• No improvement=26.8% (22/82)
• Mild improvement=26.8% (22/82)
• Moderate improvement=22% (18/82)
• High improvement=24.4% (20/82)

Maximum improvement time=13.8 months
Total improvement time=15.4 months

Mild, moderate or high improvement was reported in 78.6% (33/42) of patients with stress urinary incontinence and 67.5% (27/40) of patients with mixed urinary incontinence. The mean improvement was statistically significantly greater in the stress urinary incontinence group (p=0.008).

Younger women had statistically significantly better results (p<0.008). Patients in the high improvement group were 7.4 years younger than those in the no improvement group.

There was a statistically significantly better effect in premenopausal women than in postmenopausal women (p=0.032).

Women with a lower BMI had greater improvement (p<0.011). Patients with a lower BMI had a longer duration of improvement (p=0.029).

Further treatment
During the period between total improvement time and total follow-up time, 30% of patients returned to the same condition as before treatment but did not seek alternative treatments. 6.7% (4/60) of patients who had had some improvement (mild, moderate or high) had medical treatment (mainly parasympathomimetic drugs), 5% (3/60) had a tension-free vaginal tape-transobturator tape operation and 1 woman had repeat laser treatment.</td><td>No complications were detected.</td></tr>
<tr><td colspan="2">Abbreviations used: BMI, body mass index; ICIQ-UI SF, International Consultation on Incontinence Questionnaire-Urinary Incontinence Short Form; KHQ-UI, King's Health Questionnaire for Urinary Incontinence; SD, standard deviation</td></tr>
</table>

Study 8 Kuszka A (2019)

Details

Study type	**Case series**
Country	Germany and Switzerland
Recruitment period	Not reported
Study population and number	**n=59** Women with stress urinary incontinence
Age	Mean 49 years
Patient selection criteria	Inclusion criteria: age 18 years or older, with a clinical and urodynamic diagnosis of stress urinary incontinence or mixed urinary incontinence with predominant stress urinary incontinence. Diagnosis was based on a standardised stress provocation test supine and in a standing position with a full bladder (300 ml) and a pad weight of 5 g or more in a 1-hour test under standardised conditions. Urodynamic assessment was done using a Duet Logic (Medtronic, Germany) with a microtip catheter. Physiotherapy was recommended before laser treatment and was not allowed during the study. Women with vaginal atrophy had local oestrogens for 3 months or more before study initiation. Starting with local or systemic oestrogen treatment less than 3 months before or during the study was not allowed. Exclusion criteria: pre-existing bladder condition, including radiation treatment, pregnancy or delivery less than 6 months before study initiation, body mass index greater than 35, radical pelvic surgery, urinary tract infection or other active infections of the urinary tract or bladder, pelvic organ prolapse stage greater than 2, diagnosis of predominant urge incontinence, diagnosis of collagen disorders, and incomplete bladder emptying. Severity of stress urinary incontinence was graded by Stamey's incontinence scoring system (grade 1 = incontinence with coughing or straining, grade 2 = incontinence with change in position or walking, grade 3 = total incontinence at all times).
Technique	Device: 2940 nm Er:YAG laser (FotonaSmooth XS, Fotona, Slovenia) in the SMOOTH mode following the IncontiLase protocol (3 steps). The first step used intravaginal laser pulses with a directed angular, patterned laser beam. The second step used intravaginal laser pulses with a circular full laser beam. The final step used laser pulses of the vestibule and introitus with a straight, patterned laser. Topical anaesthetic cream was used if requested. All patients had 5 laser sessions, 1 at baseline and 1 after 1, 2, 3 and 4 months.
Follow-up	**2 years**
Conflict of interest/source of funding	None

Analysis

Follow-up issues: By 2 years after the fifth laser session, there were only 7 of the 11 patients left who had grade 3 stress urinary incontinence at baseline. The number of patients with grade 1 or 2 stress urinary incontinence remained the same.

Study design issues: Prospective case series. Objective (1-hour pad test) and subjective ICIQ-SUI SF and Pelvic Organ Prolapse/Urinary Incontinence Sexual Questionnaire (PISQ-12) data and complications were assessed at baseline, 1 month after the second and the fourth laser session and 6 months and 2 years after the fifth laser session. Patients were classed as 'cured' based on 2 g or less of urine on the 1-hour pad test or an ICIQ-SUI SF score of 5 or less. Patients were classed as 'improved' when having a 1-hour pad weight reduction more than 50% and classed as 'not cured' when pad weight reduction was 50% or less or an ICIQ-UI SF score more than 5.

Study population issues: At baseline, 54% (32/59) of patients had grade 1 stress urinary incontinence, 27% (16/59) had grade 2 and 19% (11/59) had grade 3. The mean body mass index was 26 kg/m^2. Of the 59 women, 25 (42%) were postmenopausal and 14 (24%) had mixed urinary incontinence. Six (10%) patients had intrinsic sphincter deficiency and 1 patient had had previous incontinence surgery.

IP overview: transvaginal laser therapy for stress urinary incontinence

Key efficacy and safety findings

Efficacy

Number of patients analysed: **59**

Objective cured or improvement rates

	SUI grade 1	SUI grade 2	SUI grade 3
1 month after second laser	69% (22/32)	31% (5/16)	9% (1/11)
1 month after fourth laser	78% (25/32)	63% (10/16)	9% (1/11)
6 months after fifth laser	91% (29/32)	69% (11/16)	0% (0/11)
2 years after fifth laser	78% (25/32)	50% (8/16)	0% (0/7)

Objective outcome (1-hour pad test) – pad weight (g)

	SUI grade 1 (n=32)	SUI grade 2 (n=16)	SUI grade 3 (n=11)*
Baseline, median (IQR)	7 (6 to 8)	15 (14 to 18)	35 (29 to 54)
Baseline, range	5 to 14	10 to 25	22 to 86
1 month after second laser, median (IQR)	3 (2 to 4)	9 (5 to 11)	24 (20 to 40)
1 month after second laser, range	1 to 8	3 to 20	10 to 63
1 month after fourth laser, median (IQR)	2 (1 to 4)	8 (5 to 9)	25 (20 to 41)
1 month after fourth laser, range	0 to 9	2 to 16	11 to 72
6 months after fifth laser, median (IQR)	2 (0 to 3)	7 (5 to 10)	30 (20 to 47)
6 months after fifth laser, range	0 to 10	3 to 18	13 to 75
2 years after fifth laser, median (IQR)	2 (1 to 3)	8 (3 to 12)	28 (18 to 33)
2 years after fifth laser, range	0 to 9	0 to 21	16 to 41

* by 2 years after the fifth laser session, there were only 7 SUI grade 3 patients

Objective therapy success at 6 month follow-up

Initial pad weight	Cure rate	Improvement rate	Failure rate
5 to 10 g	67% (20/30)	27% (8/30)	7% (2/30)
11 to 20 g	7% (1/15)	73% (11/15)	20% (3/15)
21 to 86 g	0%	0%	100% (14/14)

Objective outcome was not different in pre- and postmenopausal women for all SUI grades after the second or fourth laser session, and 6 months after the fifth laser session.

Objective outcome at 2 year follow-up, by menopausal status

	Premenopausal	Postmenopausal
Cured	89% (17/19)	38% (5/13)
Improved	5% (1/19)	15% (2/13)
Failed	5% (1/19)	46% (6/13)

p=0.0053

Subjective cure rates (ICIQ-UI SF)

	SUI grade 1	SUI grade 2	SUI grade 3
1 month after second laser	53% (17/32)	0%	0%
1 month after fourth laser	69% (22/32)	0%	0%
6 months after fifth laser	72% (23/32)	0%	0%
2 years after fifth laser	66% (21/32)	13% (2/16)	0%

Safety

'There were only minor complications of laser therapy.'

Weak pain during or after treatment=11% (6/57) (the pain was transient and restricted to the first few days after laser therapy).

Vaginal discharge=2% (1/57)

Data were not available for 2 patients.

Subjective outcome - ICIQ-UI SF score

	SUI grade 1 (n=32)	SUI grade 2 (n=16)	SUI grade 3 (n=11)*
Baseline, median (IQR)	10 (8 to 11)	15 (14 to 16)	18 (17 to 20)
Baseline, range	6 to 19	10 to 18	14 to 20
1 month after second laser, median (IQR)	5 (5 to 7)	10 (9 to 12)	17 (15 to 19)
1 month after second laser, range	3 to 19	6 to 17	11 to 20
1 month after fourth laser, median (IQR)	5 (2 to 6)	10 (8 to 11)	17 (16 to 19)
1 month after fourth laser, range	0 to 19	6 to 17	10 to 20
6 months after fifth laser, median (IQR)	5 (0 to 6)	9 (8 to 12)	17 (15 to 20)
6 months after fifth laser, range	0 to 19	6 to 17	9 to 20
2 years after fifth laser, median (IQR)	5 (4 to 6)	10 (8 to 15)	18 (16 to 18)
2 years after fifth laser, range	0 to 16	4 to 20	12 to 18

* by 2 years after the fifth laser session, there were only 7 SUI grade 3 patients

Subjective therapy success at 6 month follow-up

ICIQ-UI SF score at baseline	Success rate	Failure rate
6 to 10	79% (19/24)	21% (5/24)
11 to 21	11% (4/35)	89% (31/35)

Subjective outcome – PISQ-12 score

	SUI grade 1 (n=32)	SUI grade 2 (n=16)	SUI grade 3 (n=11)*
Baseline, median (IQR)	20 (16 to 22)	14 (12 to 15)	12 (10 to 12)
Baseline, range	10 to 28	12 to 18	8 to 15
1 month after second laser, median (IQR)	28 (24 to 29)	22 (19 to 25)	14 (13 to 18)
1 month after second laser, range	18 to 32	16 to 30	10 to 20
1 month after fourth laser, median (IQR)	30 (28 to 32)	23 (22 to 26	14 (13 to 15)
1 month after fourth laser, range	19 to 33	16 to 30	10 to 22
6 months after fifth laser, median (IQR)	31 (30 to 32)	24 (20 to 28)	15 (13 to 16)
6 months after fifth laser, range	17 to 34	14 to 31	12 to 23
2 years after fifth laser, median (IQR)	31 (29 to 32)	20 (18 to 28)	17 (14 to 18)
2 years after fifth laser, range	20 to 33	14 to 33	12 to 20

* by 2 years after the fifth laser session, there were only 7 SUI grade 3 patients

Abbreviations used: ICIQ-UI SF, International Consultation on Incontinence Questionnaire-Urinary Incontinence Short Form; IQR, interquartile range; PISQ-12, Pelvic Organ Prolapse/Urinary Incontinence Sexual Questionnaire; SUI, stress urinary incontinence

Study 9 Ahluwalia J (2019)

Details

Study type	**Case series**
Country	US
Recruitment period	2015 to 2019
Study population and number	**n=45** Patients with adverse events related to laser and energy-based devices for 'vaginal rejuvenation'.
Age	Not reported
Patient selection criteria	Patients with adverse events related to laser and energy-based devices for 'vaginal rejuvenation'.
Technique	Devices: fractional CO_2 laser, non-ablative Er:YAG laser, hybrid fractional laser, radiofrequency devices.
Follow-up	**Not reported**
Conflict of interest/source of funding	One author has stock options in Zalea, Inmode, Cytrellis, La Jolla Nanoparticle, serves on the scientific advisory board for Zeltiq Aesthetics, Soliton Inc., Sciton Inc., and Sienna Biopharmaceuticals, and is a paid consultant for Merz and Alastin. One author is a member of the scientific advisory boards for Sciton, Merz, Inmode, Rodan and Fields, and Allergan, and is on the speakers bureau and receives honorarium from Sciton, Inmode, Alastin and Allergan.

Analysis

Study design issues: Cross-sectional analysis of the FDA Manufacturer and User Facility Device Experience (MAUDE) database. Events related to laser and energy-based devices for vaginal rejuvenation were identified. Of the 45 reports, 31 were reported by patients, 4 by distributors, 8 by manufacturers and 2 were not specified. Devices were operated by various specialists, including urologists (n=3), dermatologists (n=3), and gynaecologists (n=7). In 22 reports, the operator was unspecified. Events were consolidated for dates, to identify distinct events.

Study population issues: Patient medical histories included vaginal atrophy (n=3), cystitis (n=2), cervical cancer (n=1), urinary incontinence (n=4), vulvar pain (n=1), 'bladder surgery' (n=1), yeast infection (n=1) and Müllerian agenesis (n=1). Indications for the procedure included vaginal dilation (n=1), lichen sclerosis (n=1), dyspareunia (n=2), urethral or vulval pain (n=2), urinary incontinence (n=6), vaginal atrophy (n=9) and 'vaginal rejuvenation' (n=13); some patients had more than 1 indication. The indication was unspecified for 16 patients.

Other issues: Reports from the MAUDE database are subject to reporting and verification biases. Reports from the database cannot be used to determine the incidence of adverse events. The authors note that these adverse events likely represent a small fraction of the total number of procedures that have been done, but this cannot be validated.

Key efficacy and safety findings

Safety
Adverse events (patients may have had more than 1 adverse event) • Pain, n=19 • Burning or numbness, n=11 • Scarring or burns, n=7 • Dyspareunia, n=6 • Increased urinary frequency or incontinence, n=4 • Redness or irritation, n=3 • Infection, n=2 • Bladder or urethral pain, n=2 • Discomfort, n=2 • Miscellaneous, n=3 Treatment included triptan, gabapentin, pregabalin, duloxetine, bupropion, hormonal creams and vaginal suppositories, platelet-rich plasma, lidocaine, Vaseline, dilators, fluconazole, antibiotics, topical steroids, over-the-counter medications, physical therapy, and acupuncture. 33 patients (12 radiofrequency, 17 fractional CO_2 laser, 2 hybrid fractional laser, 1 non-ablative Er:YAG laser, 1 unknown) reported chronic symptoms, including long-term pain, numbness, burning, bladder disturbances, dyspareunia, worsening symptoms, aggravation of lichen sclerosis, scarring and disfigurement.

Study 10 Al-Badr A (2019)

Details

Study type	**Case reports**
Country	Saudi Arabia
Recruitment period	Not reported
Study population and number	**n=3** Premenopausal women who had laser treatment for vaginal laxity
Age	52, 36 and 39 years
Patient selection criteria	Women who had laser surgery for vaginal laxity and subsequent vaginal repair procedures.
Technique	1. Er:YAG laser – 2 sessions, 1 month apart 2. CO_2 laser – 2 sessions, 1 month apart 3. Er:YAG laser – 4 sessions, 1 month apart
Follow-up	**1 year**
Conflict of interest/source of funding	Not reported

Key efficacy and safety findings

Safety
Vaginal mucosa scarring Case reports: 1. 52 year old perimenopausal woman had symptoms of a mild vaginal bulge, feelings of vaginal laxity with intercourse, vaginal wind and needing to splint for defaecation. She had stage 1 POP-Q posterior prolapse. There was no prolapse of other walls and no evidence of atrophy. The symptoms did not improve after laser treatment and she had a posterior vaginal repair about 1 year later. During the procedure, the vaginal mucosa was found to be rigid, scarred and difficult to dissect from the underlying tissues, which made the procedure difficult. The patient recovered well. 2. 36 year old woman with symptoms of vaginal laxity with intercourse and vaginal wind. She had stage 1 POP-Q posterior vaginal prolapse and stage 1 anterior vaginal prolapse. She found only minimal benefit from the laser treatment and had a posterior vaginal repair a year later. During the procedure, the vaginal mucosa of the lower vagina was found to be scarred, and difficult to dissect from underlying tissues, which made the procedure difficult. Postoperatively, the patient recovered well and the vaginal mucosa had healed well at the 7-week follow-up. 3. 39 year premenopausal woman had symptoms of vaginal laxity with intercourse, vaginal wind, vaginal bulge, and stress urinary incontinence. She had stage 2 POP-Q posterior prolapse, stage 2 anterior prolapse and positive cough stress test. One year after the laser treatment, she had a posterior vaginal repair and retropubic mid-urethral tension-free vaginal tape. During the procedure, the vaginal mucosa was found to be very thin, friable, with loss of rugae, which made the procedure difficult. There was slightly higher blood loss than usual during the procedure. Postoperatively, the patient recovered well with no prolapse or incontinence symptoms and the vaginal mucosa had healed well at the 5-week follow-up.

Study 11 Wu W (2018) – conference abstract

Details

Study type	**Case report**
Country	Taiwan
Recruitment period	Not reported
Study population and number	**n=1** Woman with stress urinary incontinence
Age	36 years
Patient selection criteria	-
Technique	Device: Er:YAG laser (2940 nm) system (XS Dynamis, Fotona, Slovenia); 1 session
Follow-up	**10 days**
Conflict of interest/source of funding	Work not supported by industry

Key efficacy and safety findings

Safety
Vesicovaginal fistula The patient presented to hospital because of urinary incontinence for 5 days. She had had laser treatment for stress urinary incontinence 5 days previously. After the laser treatment, she had total urinary incontinence especially with position change. Vaginal examination showed persistent clear fluid discharge and did not reveal any fistulous tract. A tampon test was positive. The 'most possible' diagnosis was vesicovaginal fistula caused by the laser procedure. A foley catheter was inserted for bladder drainage for 2 weeks. The symptom of urine leakage was relieved after the catheter was removed.

Validity and generalisability of the studies

- Two randomised controlled trials were identified. One compared laser treatment with sham and patients were blinded to their treatment allocation. The other trial compared laser treatment with topical oestrogen or vaginal lubricant.
- The sham-controlled randomised trial only reported follow-up to 3 months.
- There were different types of lasers and different treatment regimens used in the studies. The number of treatment sessions ranged from 1 to 5.
- Some studies included patients with mixed urinary incontinence as well as those with stress urinary incontinence.
- Some studies only included postmenopausal women. Some of the evidence suggests that outcomes are better in premenopausal women.
- One case series only included women with mild stress urinary incontinence.[4]
- The longest follow up was 36 months.[4]
- The report from the US Food and Drug Administration MAUDE database included adverse events associated with radiofrequency devices as well as those associated with lasers. Urinary incontinence was the indication for treatment in only a small proportion of the patients.[9]
- In the 3 case reports that describe vaginal scarring the indication for treatment was vaginal laxity, but 1 woman also had stress urinary incontinence.[10]

Existing assessments of this procedure

A technical bulletin on intravaginal laser for genitourinary syndrome of menopause and stress urinary incontinence was published by the Society of Obstetricians and Gynaecologists of Canada in 2018.[12] The report includes the following recommendations:

1. ‘In patients declining or with apparent contraindications to local estrogen, intravaginal laser therapy may be considered for short-term relief of symptoms associated with genitourinary syndrome of menopause’.

2. ‘There is insufficient evidence to offer intravaginal laser therapy as an equivalent modality to local oestrogen for the treatment of genitourinary syndrome of menopause (including vulvovaginal atrophy, lower urinary tract symptoms, and sexual dysfunction)’.

3. ‘There is insufficient evidence to offer intravaginal laser therapy as an effective modality for the treatment of stress urinary incontinence over alternate managements such as pelvic floor physiotherapy, incontinence pessaries, or surgery’.

4. ‘Long-term use of intravaginal laser therapy for the management of genitourinary syndrome of menopause remains experimental and should remain within the protocols of well-executed clinical trials in attempts to establish its safety and efficacy’.

A best practice consensus document, developed by the International Society for the Study of Vulvovaginal Disease and the International Continence Society, was published in 2019.[13] With regard to stress urinary incontinence, the report states: ‘There is limited evidence supporting the use of LASER for stress urinary incontinence (level of recommendation 4, grade of recommendation D). There are limited data concerning the safety of LASER for stress urinary incontinence (level of recommendation 4, grade of recommendation D).’

A committee opinion on laser-based vaginal devices for treatment of stress urinary incontinence, genitourinary syndrome of menopause, and vaginal laxity was published by the International Urogynecological Association in 2019.[14] The report concluded: ‘The therapeutic advantages of nonsurgical laser-based devices in urogynecology can only be recommended after robust clinical trials have demonstrated their long-term complication profile, safety, and efficacy’.

Related NICE guidance

Below is a list of NICE guidance related to this procedure.

Interventional procedures

- Extraurethral (non-circumferential) retropubic adjustable compression devices for stress urinary incontinence in women. NICE interventional

procedures guidance 576 (2017). Available from http://www.nice.org.uk/guidance/IPG576

- Single-incision short sling mesh insertion for stress urinary incontinence in women. NICE interventional procedures guidance 566 (2016). Available from http://www.nice.org.uk/guidance/IPG566
- Intramural urethral bulking procedures for stress urinary incontinence in women. NICE interventional procedures guidance 138 (2005). Available from http://www.nice.org.uk/guidance/IPG138

NICE guidelines

- Urinary incontinence and pelvic organ prolapse in women: management. NICE guideline 123 (2019). Available from http://www.nice.org.uk/guidance/NG123

Additional information considered by IPAC

Professional experts' opinions

Expert advice was sought from consultants who have been nominated or ratified by their professional Society or Royal College. The advice received is their individual opinion and is not intended to represent the view of the society. The advice provided by professional experts, in the form of the completed questionnaires, is normally published in full on the NICE website during public consultation, except in circumstances but not limited to, where comments are considered voluminous, or publication would be unlawful or inappropriate. One Professional expert questionnaire for transvaginal laser therapy for stress urinary incontinence was submitted and can be found on the NICE website.

Patient commentators' opinions

NICE's Public Involvement Programme will send questionnaires to NHS trusts for distribution to patients who had the procedure (or their carers). When NICE has received the completed questionnaires, these will be discussed by the committee.

Company engagement

A structured information request was sent to 4 companies who manufacture a potentially relevant device for use in this procedure. NICE received 2 completed submissions. These were considered by the IP team and any relevant points have been taken into consideration when preparing this overview.

Issues for consideration by IPAC

Below is a list of ongoing trials:

- The Efficacy and Safety of Fotona Smooth® Device for the Treatment of Stress Urinary Incontinence (NCT03098992); RCT; Germany, Greece, Ireland, Slovenia, Switzerland, UK; n=135; estimated study completion date June 2020
- Vaginal CO2 Laser for Stress Incontinence (NCT04136652); RCT; Denmark; n=40; estimated study completion date October 2021
- Intraurethral/Intravaginal 2940 nm Erbium Laser Treatment For Stress Urinary Incontinence (NCT03676894); RCT; Canada; n=55; estimated study completion date December 2021
- Laser Vaginal Treatment for Stress Urinary Incontinence (NCT03671694); RCT; Canada; n=182; estimated study completion date June 2021
- VESPER: Stress Urinary Incontinence STUDY (VESPER-SUI) (NCT03996070) [*not yet recruiting*]; RCT; n=23; estimated study completion date December 2021
- Study Comparing the Use of Laser and of Kinesiotherapy for the Treatment of Female Stress Urinary Incontinence (NCT03301142) [*recruitment status unknown*]; RCT; Brazil; n=40; estimated study completion date July 2018

References

1. Blaganje M, Scepanovic D, Zgur L et al. (2018) Non-ablative Er:YAG laser therapy effect on stress urinary incontinence related to quality of life and sexual function: A randomized controlled trial. European Journal of Obstetrics, Gynecology, and Reproductive Biology 224: 153–8
2. Aguiar LB, Politano CA, Costa-Paiva L et al. (2020) Efficacy of fractional CO_2 laser, promestriene, and vaginal lubricant in the treatment of urinary symptoms in postmenopausal women: a randomized clinical trial. Lasers in Surgery and Medicine doi: 10.1002/lsm.23220
3. Okui N (2019) Comparison between erbium-doped yttrium aluminum garnet laser therapy and sling procedures in the treatment of stress and mixed urinary incontinence. World Journal of Urology 37: 885–9
4. Gonzalez Isaza P, Jaguszewska K, Cardona JL et al. (2018) Long-term effect of thermoablative fractional CO_2 laser treatment as a novel approach to urinary incontinence management in women with genitourinary syndrome of menopause. International Urogynecology Journal 29: 211–5
5. Ogrinc UB, Sencar S, Lenasi H (2015) Novel minimally invasive laser treatment of urinary incontinence in women. Lasers in Surgery and Medicine 47: 689–97
6. Gambacciani M, Levancini M, Russo E et al. (2018) Long-term effects of vaginal erbium laser in the treatment of genitourinary syndrome of menopause. Climacteric: the Journal of the International Menopause Society 21: 148–52
7. Erel CT, Inan D, Mut A (2020) Predictive factors for the efficacy of Er:YAG laser treatment of urinary incontinence. Maturitas 132: 1–6
8. Kuszka A, Gamper M, Walser C et al. (2019) Erbium:YAG laser treatment of female stress urinary incontinence: midterm data. International Urogynecology Journal doi: 10.1007/s00192-019-04148-9
9. Ahluwalia J, Avram MM, Ortiz AE (2019) Lasers and energy-based devices marketed for vaginal rejuvenation: A cross-sectional analysis of the MAUDE database. Lasers in Surgery and Medicine 51: 671–7
10. Al-Badr A, Alkhamis WH (2019) Laser vaginal tightening complications: report of three cases. Lasers in Surgery and Medicine 51: 757–9
11. Wu W, Hsiao S, Lin H (2018) Vesicovaginal fistula after laser treatment for stress urinary incontinence. International Urogynecology Journal 29: 108
12. Walter JE, Larochelle A (2018) No. 358-Intravaginal laser for genitourinary syndrome of menopause and stress urinary incontinence. Journal of Obstetrics and Gynaecology Canada 40: 503–11

13. Preti M, Vieira-Baptista P, Digesu GA et al. (2019) The clinical role of LASER for vulvar and vaginal treatments in gynecology and female urology: an ICS/ISSVD best practice consensus document. Journal of Lower Genital Tract Disease 23: 151–60

14. Shobeiri SA, Kerkhof MH, Minassian VA et al. (2019) IUGA committee opinion: laser-based vaginal devices for treatment of stress urinary incontinence, genitourinary syndrome of menopause, and vaginal laxity. International Urogynecology Journal 30: 371–6

Literature search strategy

Databases	Date searched	Version/files
Cochrane Database of Systematic Reviews – CDSR (Cochrane Library)	20/07/2020	Issue 7 of 12, July 2020
Cochrane Central Database of Controlled Trials – CENTRAL (Cochrane Library)	20/07/2020	Issue 7 of 12, July 2020
MEDLINE (Ovid)	20/07/2020	1946 to July 17, 2020
MEDLINE In-Process (Ovid) & Medline ePub ahead (Ovid)	20/07/2020	July 17, 2020
EMBASE (Ovid)	20/07/2020	1974 to 2020 July 17

Trial sources searched

- Clinicaltrials.gov
- ISRCTN
- WHO International Clinical Trials Registry

Websites searched

- National Institute for Health and Care Excellence (NICE)
- NHS England
- Food and Drug Administration (FDA) - MAUDE database
- Australian Safety and Efficacy Register of New Interventional Procedures – Surgical (ASERNIP – S)
- Australia and New Zealand Horizon Scanning Network (ANZHSN)
- General internet search

The following search strategy was used to identify papers in MEDLINE. A similar strategy was used to identify papers in other databases.

1	Laser Therapy/
2	Lasers/ or Lasers, Gas/ or Lasers, Solid-State/
3	VAGINAL DISEASES/ or Vagina/ or VULVA/
4	2 and 3
5	((treatment* or device* or therap* or appl* or fractional or surg* or scapel* or carbon dioxide* or non-ablative or transvaginal* or vagina* or procedure*) adj4 (laser* or lazer*)).ti,ab.

6	(Alma Pixel CO2 laser* or FEMILIFT CO2 LASER* or SMARTXIDE* or IntimaLase* or RenovaLase* or Incontilase* or Fotana*).mp.
7	1 or 4 or 5 or 6
8	exp Urinary Incontinence, Stress/
9	(SUI or (incont* adj4 (urin* or stress*))).ti,ab.
10	(sphincter adj4 (defic* or dysfunct*)).tw.
11	exp Urethra/
12	(urethra* adj4 hypermob*).ti,ab.
13	or/8-12
14	7 and 13
15	VAGINA/ or VULVA/
16	Atrophy/
17	PRURITUS/ or PRURITUS VULVAE/
18	DEHYDRATION/
19	DYSPAREUNIA/
20	16 or 17 or 18 or 19
21	15 and 20
22	VULVOVAGINITIS/ or Atrophic Vaginitis/ or Vaginitis/
23	FEMALE UROGENITAL DISEASES/
24	exp VULVAR DISEASES/
25	VAGINAL DISEASES/
26	vulvovagini*.ti,ab.
27	((vagina* or vulvovagina* or urogenital or genitourinary or genito-urinary) adj4 (atroph* or dry* or pruritis or sore* or irrita* or itch* or pain* or dyspar?euni* or dysuri* or discharge* or discomfort* or erosion or dehydrat* or thin* or inflam* or burn*)).ti,ab.
28	(vaginitis adj4 atroph*).ti,ab.
29	(genitourinary syndrome of the menopause or genito-urinary syndrome of the menopause or GSM).ti,ab.
30	or/21-29
31	7 and 30
32	Animals/ not Humans/
33	14 not 32
34	31 not 32

Appendix

The following table outlines the studies that are considered potentially relevant to the IP overview but were not included in the main data extraction table (table 2). It is by no means an exhaustive list of potentially relevant studies.

Article	Number of patients/ follow-up	Direction of conclusions	Reasons for non-inclusion in table 2
Athanasiou S, Pitsouni E, Grigoriadis T et al. (2019) Microablative fractional CO2 laser for the genitourinary syndrome of menopause: Up to 12-month results. Menopause 26: 248-255	Case series n=94 FU=12 months	All genitourinary syndrome of menopause symptoms improved statistically significantly. The positive laser effect remained unchanged throughout the 12 months of follow-up. Four or 5 laser therapies may be superior in lowering the intensity of symptoms in comparison to 3 laser therapies, in short and long-term follow-up. Differences between 4 and 5 laser therapies were not found.	The main focus of the study is genitourinary syndrome of menopause and not specifically stress urinary incontinence.
Barber MA, Eguiluz I (2016) Patient satisfaction with vaginal erbium laser treatment of stress urinary incontinence, vaginal relaxation syndrome and genito-urinary syndrome of menopause. Journal of the Laser and Health Academy 1: 18–23	Case series n=40	Urinary incontinence improved in 75% of the patients (n=15/21) who had stress urinary incontinence; 86% (n=13/15) of these referred to the improvement as important.	Studies with more patients or longer follow-up are included.
Behnia-Willison F, Nguyen TTT, Norbury AJ et al. (2020) Promising impact of platelet rich plasma and carbon dioxide laser for stress urinary incontinence. European Journal of Obstetrics and Gynecology and Reproductive Biology X 5: 100099	Case series n=62 FU=12 months	66% (41/62) of patients reported improved SUI symptoms from 3 to 12 months ($p<0.001$) and at 12 months, 62% (23/37) of patients reported improved SUI symptoms ($p<0.001$). From 3 to 12 months, all bladder function variables were improved ($p<0.002$). At 12 months, improvements ($p<0.03$) were maintained for all bladder function variables, except pad usage ($p=0.073$).	Treatment included platelet rich plasma as well as laser therapy.
Behnia-Willison F, Nguyen TTT, Mohamadi B et al. (2019) Fractional CO2 laser for treatment of stress urinary incontinence. European Journal of Obstetrics and Gynecology and Reproductive Biology: X 1: 100004	Case series n=58 FU=12 to 24 months	82% of patients reported an improvement in symptoms of SUI at completion of treatment (mild to no SUI) ($p\leq0.01$). Treatment effect waned slightly when assessed at follow-up. 71% of patients reported ongoing improvement in SUI symptoms at 12-24 months ($p<0.01$).	Studies with more patients or longer follow-up are included.
Behnia-Willison F, Sarraf S, Miller J et al. (2017) Safety and long-term efficacy of fractional	Case series n=102	In this study, fractional microablative CO_2 laser treatment was associated with an	The main focus of the study is genitourinary

CO2 laser treatment in women suffering from genitourinary syndrome of menopause. European Journal of Obstetrics, Gynecology, and Reproductive Biology 213: 39-44	FU=12 to 24 months	improvement in symptoms of GSM and sexual function.	syndrome of menopause and not specifically stress urinary incontinence.
Bhide AA, Khullar V, Swift S et al. (2019) The use of laser in urogynaecology. International Urogynecology Journal 30: 683-692	Review 25 studies	The results of individual studies indicate that both CO_2 and erbium lasers are effective in treating urogynaecological conditions. There is a lack of good-quality evidence in the form of multi-centre randomised placebo-controlled trials. The safety and effectiveness of these laser devices have not been established. Use of lasers may lead to serious adverse events such as vaginal burns, scarring, dyspareunia and chronic pain. Randomised placebo-controlled trials in addition to formal evaluation of the laser devices are required before this treatment modality can be recommended.	No meta-analysis. All relevant studies are included in table 2 or the appendix.
Conte C, Jauffret T, Vieillefosse S et al. (2017) Laser procedure for female urinary stress incontinence: A review of the literature. Progres en urologie 27: 1076-1083	Review 7 studies FU=5 to 36 months	Improvement rates ranged from 62% to 78%. No major adverse events were noted. Minor side effects included sensation of warmth, increased vaginal discharge and transient urge urinary incontinence.	No meta-analysis. All relevant studies are included in table 2 or the appendix.
Dabaja H, Lauterbach R, Matanes E et al. (2019) The safety and efficacy of CO2 laser in the treatment of stress urinary incontinence. International Urogynecology Journal doi: 10.1007/s00192-019-04204-4	Case series n=33 FU=6 months	Sanitary pad usage decreased from a median of 12 per day at baseline to 7 at 1 to 3 months after treatment ($p<0.0001$) and returned to 12 at 6 months after treatment. Scores on the Urogenital Distress Inventory and the ICIQ decreased (improved) at 1 to 3 months follow-up: from 45 ± 2 and 16 ± 4, respectively, to 29.3 ± 14.7 and 8.15 ± 3.1, respectively ($p<0.0001$). The scores returned to levels similar to baseline at 6 months after treatment. Patients reported mild and transient side effects, with significant improvement in quality of life.	Studies with more patients or longer follow-up are included.
Elbiaa A, Abdelazim I, Hussain M et al. (2015) Minimal invasive laser treatment for female stress urinary incontinence. Obstetrics & Gynecology International Journal 2: 77-80	Case series n=50 FU=6 months	Residual urine volume increased from 17 ml before treatment to 38 ml after treatment, and first sensation increased from 54 ml before treatment to 122 ml after treatment. First desire increased from 75 ml before treatment to 180 ml after treatment and strong	Studies with more patients or longer follow-up are included.

		desire increased from 150 ml before treatment to 250 ml after treatment.	
Fistonic I, Fistonic N (2018) Baseline ICIQ-UI score, body mass index, age, average birth weight, and perineometry duration as promising predictors of the short-term efficacy of Er:YAG laser treatment in stress urinary incontinent women: A prospective cohort study. Lasers in Surgery and Medicine 50: 636-43	Case series n=85 FU=2 to 6 months	A relevant decrease in ICIQ-UI (MID) of ≥30% can be predicted based on age, body mass index, average birth weight, perineometer squeeze duration, and ICIQ-UI scores before the intervention. The best results should be expected in younger women with a body mass index of ≤23.3, average birth weight >3.6 kg, ICIQ-UI at a baseline of ≤10, and perineometer squeeze duration at a baseline of ≥3.51 seconds. The critical age for Er:YAG laser effect is 47.5 years.	Studies with more patients or longer follow-up are included.
Fistonic N, Fistonic I, Gustek SF et al. (2016) Minimally invasive, non-ablative Er:YAG laser treatment of stress urinary incontinence in women--a pilot study. Lasers in Medical Science 31: 635-43	Case series n=31 FU=6 months	Primary endpoint, the change in ICIQ-UI score, showed clinically relevant and statistically significant improvement after all follow-ups compared to baseline scores. There was also improvement in the secondary endpoints. Only mild and transient adverse events and no serious adverse events were reported.	Studies with more patients or longer follow-up are included.
Fistonic N, Fistonic I, Lukanovic A et al. (2015) First assessment of short-term efficacy of Er:YAG laser treatment on stress urinary incontinence in women: prospective cohort study. Climacteric: the Journal of the International Menopause Society 18 suppl1: 37-42	Case series n=73 FU=2 to 6 months	The score in the ICIQ-UI SF was reduced to a median of 46% (95% CI 33 to 67%, p<0.001). The reduction was higher in women with normal body mass index (67%) than in overweight women (25%), as well as in women younger than 39 years (100%) compared with those older than 60 years (8%) (p<0.001). No serious adverse events were noticed.	Studies with more patients or longer follow-up are included.
Franic D, Fistonic I (2019) Laser Therapy in the Treatment of Female Urinary Incontinence and Genitourinary Syndrome of Menopause: An Update. BioMed Research International 2019: 1576359	Review	This review's aim is to present the evidence-based medical data and laser treatment of SUI and GSM in an outpatient setting to be a good treatment option, regarding short-term as well as long-term follow-ups. Long-term follow-up studies are needed to confirm that laser treatment is a good, painless outpatient procedure with no side effects in postmenopausal women.	No meta-analysis. All relevant studies are included in table 2 or the appendix.
Gambacciani M, Palacios S (2017) Laser therapy for the restoration of vaginal function. Maturitas 99: 10-15	Review	Although large randomised trials have not been reported, the evidence suggests that laser therapy can be offered as a safe and efficacious alternative to hormone replacement therapy (HRT) for GSM, as well as a first-line treatment for mild to moderate	No meta-analysis. All relevant studies are included in table 2 or the appendix.

		SUI, before surgical procedures are resorted to. Randomised studies are needed to compare laser treatments with other therapies, as well as to assess the duration of the therapeutic effects and the safety of repeated applications.	
Gambacciani M, Levancini M, Cervigni M (2015) Vaginal erbium laser: the second-generation thermotherapy for the genitourinary syndrome of menopause. Climacteric: the Journal of the International Menopause Society 18: 757-63	Non-randomised comparative study n=70 (19 SUI) FU=24 weeks	In postmenopausal women suffering from mild to moderate SUI, laser treatment was associated with a statistically significant ($p<0.01$) improvement of ICIQ-SF scores. The effects were rapid and long lasting, up to the 24th week of the observation period. The procedure was well tolerated with less than 3% of patients discontinuing treatment because of adverse events.	A larger, more recent study from the same author is included.
Gambacciani M, Levancini M (2015) Short-term effect of vaginal erbium laser on the genitourinary syndrome of menopause. Minerva Ginecologica 67: 97-102	Case series n=65 (21 SUI) FU=4 weeks	Laser treatment induced a statistically significant ($p<0.01$) improvement of ICIQ-SF scores in postmenopausal women with SUI. It was well tolerated with less than 2% of patients discontinuing treatment because of adverse events.	A larger, more recent study from the same author is included.
Gaspar A, Maestri S, Silva J et al. (2018) Intraurethral Erbium:YAG laser for the management of urinary symptoms of genitourinary syndrome of menopause: A pilot study. Lasers in Surgery and Medicine 50: 802-807	Case series n=29 FU=6 months	ICIQ-SF improved by an average of 64% at 3 months and by 40% at 6 months. The 1-hour pad test showed a reduction of the quantity of leaked urine by 59% at 3 months and by 42% at 6 months. All urinary symptoms of GSM improved. Dysuria dropped to 13% and 31% of baseline values at 3 and 6 months respectively, urinary urgency dropped to 23% and 47% and frequency dropped to 22% and 43% after 3 and 6 months, respectively. Adverse effects were mild and transient.	Studies with more patients or longer follow-up are included.
Gaspar A, Brandi H (2017) Non-ablative erbium YAG laser for the treatment of type III stress urinary incontinence (intrinsic sphincter deficiency). Lasers in Medical Science 32: 685-691	Case series n=22 FU=6 months	Despite the limitations of this study, being small patient number and short follow-up, this non-ablative intraurethral erbium YAG laser procedure seems to be a safe and efficacious alternative for patients with type III stress urinary incontinence.	Studies with more patients or longer follow-up are included.
Lapii GA, Yakovleva AY, Neimark AI (2017) Structural reorganization of the vaginal mucosa in stress urinary incontinence under conditions of Er:YAG laser treatment.	Case series	Studies after Er:YAG laser exposure showed signs of neocollagenogenesis and elastogenesis, foci of neoangiogenesis, reduction of epithelial degeneration and	Study focuses on pathology analysis of specimens.

Bulletin of Experimental Biology and Medicine 162: 510-514		atrophy, and an increase of the fibroblast population. Morphometry showed that the volume density of blood capillaries and the thickness of the epithelial layer increased by 61 and 65%, respectively. The use of IncontiLase technology in stress incontinence led to structural reorganization of the vaginal mucosa, improving its morphology and function and alleviating the symptoms of incontinence.	
Lin K-L, Chou S-H, Long C-Y (2019) Effect of Er:YAG laser for women with stress urinary incontinence. BioMed Research International 2019: 7915813	Case series n=41 FU=6 months	Statistically significant improvements in both urinary frequency and incontinence were found 6 months after Er:YAG laser treatment when compared to the baseline results (p<0.001). The treatment efficacy for SUI at 6 months was 76% (31/41). Bladder neck mobility by perineal ultrasonography decreased significantly (16.1 +/- 6.4 mm to 10.5 +/- 4.6 mm) after treatment (p=0.039). No permanent adverse events were found.	Studies with more patients or longer follow-up are included.
Lin H-Y, Tsai H-W, Tsui K-H et al. (2018) The short-term outcome of laser in the management of female pelvic floor disorders: Focus on stress urine incontinence and sexual dysfunction. Taiwanese Journal of Obstetrics & Gynecology 57: 825-829	Case series n=31	ICI-Q-SF scores decreased from 9.14 +/- 6.08 to 5.45 +/- 4.05 for all 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 +/- 5.84 g to 1.54 +/- 3.18 g, p=0.224).	Studies with more patients are included.
Lin Y-H, Hsieh W-C, Huang L et al. (2017) Effect of non-ablative laser treatment on overactive bladder symptoms, urinary incontinence and sexual function in women with urodynamic stress incontinence. Taiwanese Journal of Obstetrics & Gynecology 56: 815-820	Case series n=30 FU=3 months	3 months after therapy, mean 1-hour pad test statistically significantly decreased (p=0.039).	Studies with more patients or longer follow-up are included.
Mackova K, Van daele L, Page A-S et al. (2020) Laser therapy for urinary incontinence and pelvic organ prolapse: a systematic review. BJOG: An International Journal of Obstetrics and Gynaecology	Review (15 studies on stress urinary incontinence)	All studies on vaginal or urethral laser application for pelvic organ prolapse and urinary incontinence report improvement, but the quality of studies needs to be improved.	No meta-analysis.
Pagano I, Gieri S, Nocera F et al. (2017) Evaluation of the CO2 laser therapy on vulvo-vaginal atrophy (VVA) in oncological patients:	Case series n=33 FU=3 months	Reductions in the frequency and severity of SUI symptoms (p<0.01) were noted during the treatment period and were maintained after	Studies with more patients or longer follow-up are included.

preliminary results. Journal of Cancer Therapy 8: 452-463		for at least 3 months after completion of the treatment course.	
Palacios S, Ramirez M (2020) Efficacy of the use of fractional CO2RE intima laser treatment in stress and mixed urinary incontinence. European Journal of Obstetrics and Gynecology and Reproductive Biology 244: 95-100	Case series n=25	Laser treatment resulted in a significant improvement (p<0.001) in the scores of both the ICIQ-UI questionnaire and the Sandvik index. Improvements in UI severity was also achieved; after the first laser treatment, a statistically significant improvement in severity was seen (p<0.01), the significance of which increased after the second and third treatment sessions (p<0.001).	Studies with more patients or longer follow-up are included.
Pardo JI, Sola VR Morales AA (2016) Treatment of female stress urinary incontinence with Erbium-YAG laser in non-ablative mode. European Journal of Obstetrics, Gynecology, and Reproductive Biology 204: 1-4	Case series n=42 FU=6 months	ICIQ-SF median score was 11 before treatment and 3 after 6 months, with a statistically significant difference per patient (p<0.001). 79% (n=33) reported improvement and 38% (n=16), a complete healing of SUI at follow up. 67% (n=28) reported high satisfaction. Only mild pain during the procedure was reported as adverse effect.	Studies with more patients or longer follow-up are included.
Pergialiotis V, Prodromidou A, Perrea DN et al. (2017) A systematic review on vaginal laser therapy for treating stress urinary incontinence: Do we have enough evidence? International Urogynecology Journal 28: 1445-1451	Systematic review 13 studies (n=818)	According to the existing evidence, laser therapy may be a useful, minimally invasive approach for treating SUI. However, the methodological limitations of included studies render them prone to significant bias, limiting their scientific integrity.	No meta-analysis. More recent studies are included.
Phillips C, Hillard T, Salvatore S et al. (2020) Lasers in gynaecology. European Journal of Obstetrics and Gynecology and Reproductive Biology 251: 146–55	review	The authors recommend further independently or nationally funded, large multicentre randomised controlled trials are needed to assess efficacy and safety of each laser as well as any dose related effects. There are several studies underway and results should be available over the next few years. Best practice in treatments for incontinence and prolapse would also dictate that if used, a database of indication, assessment, treatment regimens including energy settings, number of passes and follow up outcomes should be mandatory.	No meta-analysis.
Pitsouni E, Grigoriadis T, Falagas M et al. (2017) Laser therapy for the genitourinary syndrome of menopause. A systematic review and meta-analysis. Maturitas 103: 78-88	Systematic review and meta-analysis 14 studies (n=542)	Overall urinary incontinence decreased statistically significantly at 1-month follow-up and the result maintained up to 6 months follow-up (low quality evidence). Pooled mean difference for urinary	Only 2 studies were included for meta-analysis of urinary incontinence.

		incontinence=-4.9 (95% CI -6.4 to -3.4).	More recent studies are included.
Pitsouni E, Grigoriadis T, Tsiveleka A et al. (2016) Microablative fractional CO2-laser therapy and the genitourinary syndrome of menopause: An observational study. Maturitas 94: 131-136	Case series n=53 FU=4 weeks	Dyspareunia, dryness, burning, itching, dysuria, frequency, urgency, urgency incontinence, stress incontinence and scores on the ICIQ-FLUTS, ICIQ-UI SF, UDI-6 and KHQ decreased.	Studies with more patients or longer follow-up are included.
Priyanka B, Abha K, Khandelwal R et al. (2019) Novel therapies in management of stress urinary incontinence. Journal of South Asian Federation of Obstetrics and Gynaecology: 10.5005/jp-journals-10006-1730	Review	Conclusive evidence is still lacking. Laser is costly, and lack of long-term safety appears to be a setback for this modality. Randomised control studies are needed to objectively define the role of laser therapy in SUI.	All relevant studies are already included in table 2 or the appendix.
Reisenauer C, Hartlieb S, Schoenfisch B et al. (2019) Vaginal therapy of mild and moderate stress urinary incontinence using Er:YAG laser: a real treatment option. Archives of Gynecology and Obstetrics 300: 1645-1650	Case series n=33 FU=6 months	The average quality of life (QoL) showed a statistically significant improvement 5 months after both Er:YAG laser applications. The mean QoL score was 6.0 and improved to a mean of 7.6 (p=0.004). The mean ICIQ-SF score changed from 12.3, median 13, range 8-18) before treatment to 6.8 (median 7, range 0-15) at 6 months after treatment (p<0.001). 75% (24/32) of patients would choose to have the therapy again and 78% (25/32) of patients would recommend it to a friend. The rate of side effects was low and none of the patients needed medical treatment.	Studies with more patients or longer follow-up are included.
Robinson D, Flint R, Veit-Rubin N et al. (2020) Is there enough evidence to justify the use of laser and other thermal therapies in female lower urinary tract dysfunction? Report from the ICI-RS 2019. Neurourology and Urodynamics	Review	Currently, there is little evidence to support the use of laser and radiofrequency in patients with stress urinary incontinence and urogenital prolapse although usage is increasing, and, therefore, there is an urgent need to gain evidence supporting safety and effectiveness, especially in light of recent warnings.	No meta-analysis.
Romero-Otero J, Lauterbach R, Aversa A et al. (2020) Laser-based devices for female genitourinary indications: position statements from the European Society for Sexual Medicine (ESSM). Journal of Sexual Medicine 17: 841–8	Review	It is too early in the evolution and research of laser-based devices to make decisive recommendations regarding vaginal treatments. There is need for randomised controlled trials with proper design for safety reasons, possible harm, and short- and long-term benefits for the different indications studied.	No meta-analysis.

Song S, Budden A, Short A et al. (2018) The evidence for laser treatments to the vulvo-vagina: Making sure we do not repeat past mistakes. The Australian & New Zealand Journal of Obstetrics & Gynaecology 58: 148-162	Systematic review 7 studies on urinary incontinence (n=408)	Strong evidence for laser efficacy and safety is limited and warrants more robust, placebo-controlled, randomised trials before widespread implementation.	No meta-analysis. All relevant studies are included in table 2 or the appendix.
Su C-F, Chen G-D, Tsai H-J (2019) Preliminary outcome of non-ablative vaginal Erbium laser treatment for female stress and mixed urinary incontinence. Taiwanese Journal of Obstetrics and Gynecology 58: 610-613	Case series n=20 FU=3 months	All 20 patients had SUI symptom relief and improvement with treatment satisfaction. Of the 10 patients with SUI only, 7 had marked improvement. Of the 10 patients with mixed urinary incontinence, 4 had marked improvement.	Studies with more patients or longer follow-up are included.
Tien Y-W, Hsiao S-Mou, Lee C-N et al. (2017) Effects of laser procedure for female urodynamic stress incontinence on pad weight, urodynamics, and sexual function. International Urogynecology Journal 28: 469-476	Case series n=35 FU=6 months	39% (11/28) of women with baseline pad weights >1 g were objectively cured and 39% (11/28) improved. Among the 18 women with mild USI, 50% were cured and 28% improved. Among 10 women with baseline pad weight >10 g, 2 were cured and 6 improved. Among the 32 women with complete questionnaire data at 6 months, 7 (22%) were subjectively cured, and 4 (13%) improved. Regarding LUTS, the majority of domains on the King's Health Questionnaire and female sexual desire and function exhibited significant improvements. Urodynamic values did not differ across the timeline.	Studies with more patients or longer follow-up are included.
Vizintin Z, Rivera M, Fistonić I et al. (2012) Novel Minimally Invasive VSP Er:YAG Laser Treatments in Gynecology. Journal of the Laser and Health Academy 1: 46–58	Review	Based on the presented initial clinical results, the IntimaLase™ and IncontiLase™ treatment protocols are promising to become minimally invasive solutions of choice for many patients suffering from vaginal relaxation syndrome and stress urinary incontinence. Further clinical studies are currently under way in several international clinical centres to confirm the safety and efficacy of the new treatment on a larger number of patients and with longer follow up times, some of which have already exceeded 12 months.	More recent studies are included.