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REVIEW ARTICLE

The effect of percutaneous tibial nerve stimulation (PTNS) on sexual function: a systematic review and meta-analysis

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Abstract

Introduction Percutaneous tibial nerve stimulation (PTNS) is now an established treatment of pelvic floor dysfunction such as overactive bladder, faecal incontinence or voiding dysfunction. Prevalence of female sexual dysfunction is high in this group. We aim to examine the effect of PTNS on sexual function in this patient group by systematically reviewing the literature and pooling the data in a meta-analysis.

Methods The literature search was conducted using the MEDLINE, Embase and CINAHL databases. Initial results yielded 74 citations. From these, nine articles met our inclusion criteria. Two articles were doubly reported, leaving seven studies in the systematic review. Only four studies reported sufficient information to be included in our meta-analysis.

Results Three studies were randomised controlled trials, and five were before-after studies. The number of participants in each study ranged from 11 to 220. Four out of seven studies reported a positive effect of PTNS on sexual function. In the meta-analysis of four studies there was a significant improvement in general sexual function with PTNS ($p = 0.04$, SMD –0.41, CI[−0.79, –0.03], $I^2 = 0\%$). In a subgroup analysis of the bowel domain of sexual function, there was a significant improvement with PTNS ($p = 0.03$, MD 17.7, CI [1.92, 33.47], $I^2 = 0\%$).

Conclusion We report a systematic review on the effect of PTNS on sexual function. Although the studies are of small size, the results are promising in terms of a positive effect of PTNS on sexual function, and we recommend further research in this area.

Keywords Percutaneous tibial nerve stimulation · PTNS · Sex

Introduction

Percutaneous tibial nerve stimulation (PTNS), also referred to as posterior tibial nerve stimulation, is a minimally invasive form of neuromodulation. It is used to treat pelvic floor dysfunctions through stimulation of the sacral plexus S2–4, indirectly via the tibial nerve.

Neuromodulation is establishing as an effective modality to treat patients with conditions such as overactive bladder (OAB), faecal incontinence (FI) and voiding dysfunction. In the UK, the National Institute for Health and Care Excellence (NICE) guidelines on Urinary Incontinence recommend PTNS be used in the treatment of OAB when conservative measures have failed and intravesical botulinum toxin and sacral nerve stimulation are not acceptable to the patient [1]. Patients may choose to have PTNS treatment to avoid the risks associated with more invasive treatments, such as urinary retention and need for long-term intermittent self-catheterisation with intravesical botulinum toxin, and the morbidity and re-operation rate associated with sacral neuromodulation [1]. In contrast, side effects from PTNS are minimal and transient. They include minor bleeding, inflammation and discomfort at the needle electrode insertion site (superior and posterior to the medial malleolus) [2]. With this in mind, it is understandable that women may elect for this less invasive option, accepting the reduced success rates (54–77% improvement in OAB symptoms compared with 72% with intravesical botulinum toxin and 65–80% with sacral neuromodulation) [3]. Furthermore, with the advent of implantable PTNS devices, the popularity of this treatment may be set to increase, although at present these devices are still in research phase [4].

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Female sexual dysfunction (FSD) is defined as persistent, recurrent problems with sexual response, desire, orgasm or pain, which causes distress or strain on a relationship [5]. Prevalence reports worldwide are variable [6], but this is a common disorder with an estimated lifetime prevalence of 15.5% in the UK [5]. Causes are wide-ranging and aetiology is often multifactorial [7]. Treatment often therefore involves more than one approach and can be prolonged [7]. It follows that FSD is associated with significant financial implications [8], and any advances in the management of this condition would surely be welcomed.

The prevalence of FSD in patients with pelvic floor dysfunction is particularly high [9], with 50% of incontinent women reporting a reduction in sexual desire, embarrassment due to OAB symptoms and loss of self-image [10, 11]. Women with OAB also reported difficulty in achieving orgasm because of pain, fear of incontinence or anxiety [10].

It is uncertain whether FSD is highly prevalent in this patient group simply because of the embarrassment and anxiety associated with pelvic floor dysfunction or whether both dysfunctions share the same aetiology. It is plausible that disturbance in the S2–4 complex may manifest as both OAB symptoms, and also as sexual dysfunction, with the latter effect potentially being mediated via the pudendal nerve supply. An epidemiological survey in the US found a significant association between the presence of urinary symptoms and arousal disorders and sexual pain [12]. In addition, a study by Parnell et al. demonstrated abnormal pudendal nerve function in women with refractory overactive bladder and voiding dysfunction by testing pudendal nerve terminal motor latencies. Furthermore, sexual function in these women improved after sacral neuromodulation treatment [13, 14].

If PTNS is found to improve FSD in this patient group, it may do so indirectly, by improving urinary and bowel symptoms, or it may have an independent effect, through direct neuromodulation of the nervous supply to the vulva, vagina and surrounding musculature, with potential implications in the functions of lubrication and genital sensation.

There is limited existing evidence regarding the relationship between PTNS and sexual function. Of the few studies to be published, the majority report sexual function as a secondary outcome of treatment when PTNS has been used to treat a different primary condition such as OAB, pelvic pain or faecal incontinence. We aim to produce a systematic review of the literature examining the effect of PTNS on sexual function in women receiving treatment for pelvic floor disorders. We will pool the data in a meta-analysis where appropriate.

Methods

Ethical approval was deemed unnecessary as this is secondary research. The systematic review was carried out according to the PRISMA statement [15].

Identification of studies

We performed a literature search of the MEDLINE, Embase and CINAHL (Cumulative index of nursing and allied health literature) databases, from database inception to July 2017, using the Healthcare Databases Advanced Search platform. Our search strategies consisted of text words and word variations for the concepts of 'percutaneous', 'posterior tibial', 'nerve stimulation' and 'sexual function', and the searches were then amalgamated. We did not put any restrictions on the search. The literature search was updated in December 2018 but did not yield any additional articles that were suitable to be included in our review.

We also included an additional abstract, which although it did not appear in the database search, was found from searching relevant online conference proceedings (ICS 2010-17, IUGA 2015-17). All studies included were published in peer-reviewed journals or conference proceedings.

Study selection and data extraction processes

From the citations identified by the database search, the abstracts were screened and selected according to our inclusion criteria:

Population: Adult females suffering from pelvic floor disorders including overactive bladder, faecal incontinence, voiding dysfunction and pelvic pain.
Intervention: PTNS. Studies involving transcutaneous posterior tibial nerve stimulation were excluded.
Comparator: We included studies which compared sexual function after PTNS treatment to that before it or to that in a control group. We did not include case reports or case series publications.
Outcome: Sexual function as measured by a validated tool.

The following data items were collected from each study that met the inclusion criteria: study type, number of participants, age of participants, type of pelvic floor disorder, tool used to measure sexual function and score of the sexual function tool at comparison points. We contacted authors via email for any further information that was required. All studies meeting the inclusion criteria were included in the systematic review. Only studies that reported sufficient data were included in

the meta-analysis. When studies were reported in more than one conference abstract or publication, the most complete data set was used.

Methodological quality assessment and data synthesis

Data on female sexual function scores with/without PTNS were used to populate 2 × 2 tables and generate standardised mean difference, confidence intervals and *p* values. When raw data were supplied, Stata 14.2 software (StataCorp LLC, College Station, TX, USA) was used to calculate mean and standard deviation values where necessary. Statistical analysis was performed using Review Manager 5.3 (Cochrane Collaboration). We also used the Review Manager online calculator from the Cochrane Group to estimate standard deviation from the *p* values of the difference in the means where necessary. Two tools for sexual function featured in the meta-analysis, each with different scoring systems: ePAQ-PF (electronic Personal Questionnaire-Pelvic Floor), scored out of 100 [16], and FSFI (Female Sexual Function Index), scored out of 36 [17]. For this reason, we used a standardised mean difference. In addition, the ePAQ-PF scores were multiplied by −1 so that both scores reflected improvement in sexual function in the same direction. We used a random effect model to account for the other factors that can affect sexual function other than PTNS. Heterogeneity was evaluated graphically using forest plots and statistically using the I^2 statistic. Subgroup analysis was performed in the studies which utilised the ePAQ-PF tool by examining the effect of PTNS on the individual domains of sexual function (bowel, urinary, vaginal, dyspareunia). We were unable to perform subgroup analysis in the studies which utilised the FSFI tool as the score for each individual domain was not reported by one of the two studies, despite attempts to obtain these data by contacting the author.

Quality assessment of the studies was performed using a previously published tool [14], which was adapted slightly according to the studies in our review. We note this is not a validated instrument. The quality score was based on the following criteria and a score ≥ 4 was considered high quality:

1. Size of the study (≥ 100 participants score = 1, < 100 participants score = 0)
2. Sexual function assessment tool (tool with a high level of validation = 1, tool that does not have a high level of validation = 0)
3. Follow-up: We felt the optimal time for follow-up is at 3–6 months as most PTNS treatment protocols are 8–12 weeks (follow-up 3-6 months score = 1, follow-up outside this time frame score = 0)
4. Presence of a control group (presence of control group score = 1, absence of control group score = 0)
5. Percentage of participants lost to follow-up (< 20% participants lost to follow-up score = 1, ≥ 20% participants lost to follow-up score = 0)

Results

Figure 1 shows the flow of literature from identification of citations through to inclusion of the studies in the review. Our initial search yielded 74 articles. We then discarded irrelevant or duplicate articles. We also excluded one study in which none of the participants were sexually active after the PTNS treatment.

A paper by Musco et al. published in 'Neurology and Urodynamics' in 2014 was discarded as the author was unable to guarantee that the same data did not feature in a larger study also published by Musco et al. in the 'Journal of Sexual Medicine' in 2016. Thus, we did not want to have the risk of any duplicate data. A further conference abstract by Perinparajah et al. published in 'Colorectal Disease' in 2012 was discarded after the senior author confirmed via email that this same data set was reported in a larger study published by Kelly et al. in 'Colorectal Disease' in 2016.

This left seven studies which were included in our review and four of these reported sufficient data to be included in the meta-analysis.

Table 1 summarises the characteristics of the studies included in this review and meta-analysis. There were three randomised controlled trials (RCTs) and four before-after studies.

The number of participants varied from 11 to 220. In the study by Kelly et al. there were initially 110 participants but only 60 completed follow-up and only 15 of these had a complete data set that could be used in the meta-analysis [18]. In the study by Eftekhar et al. there were 50 participants randomised; however, 2 from the PTNS group and 8 from the control group withdrew, leaving a total of 40 remaining participants [19]. In the study by Craig et al. there were initially 41 participants but there was a complete data set for only 11 of these in the sexual function domains [20]. In the study by Van Balken et al. there were 121 participants but only 76 were female [21]. The mean age of participants was 56 years in the studies that reported this. Three studies were involving women undergoing treatment for OAB, one study involved women undergoing treatment for faecal incontinence, one study involved women undergoing treatment for pelvic pain and two studies involved a combination of pelvic floor problems.

Of the four studies included in the meta-analysis, two used the FSFI tool and two used the ePAQ-PF tool. Data from 75 participants were involved in the meta-analysis. Four out of seven studies reported a positive effect of PTNS on sexual function.

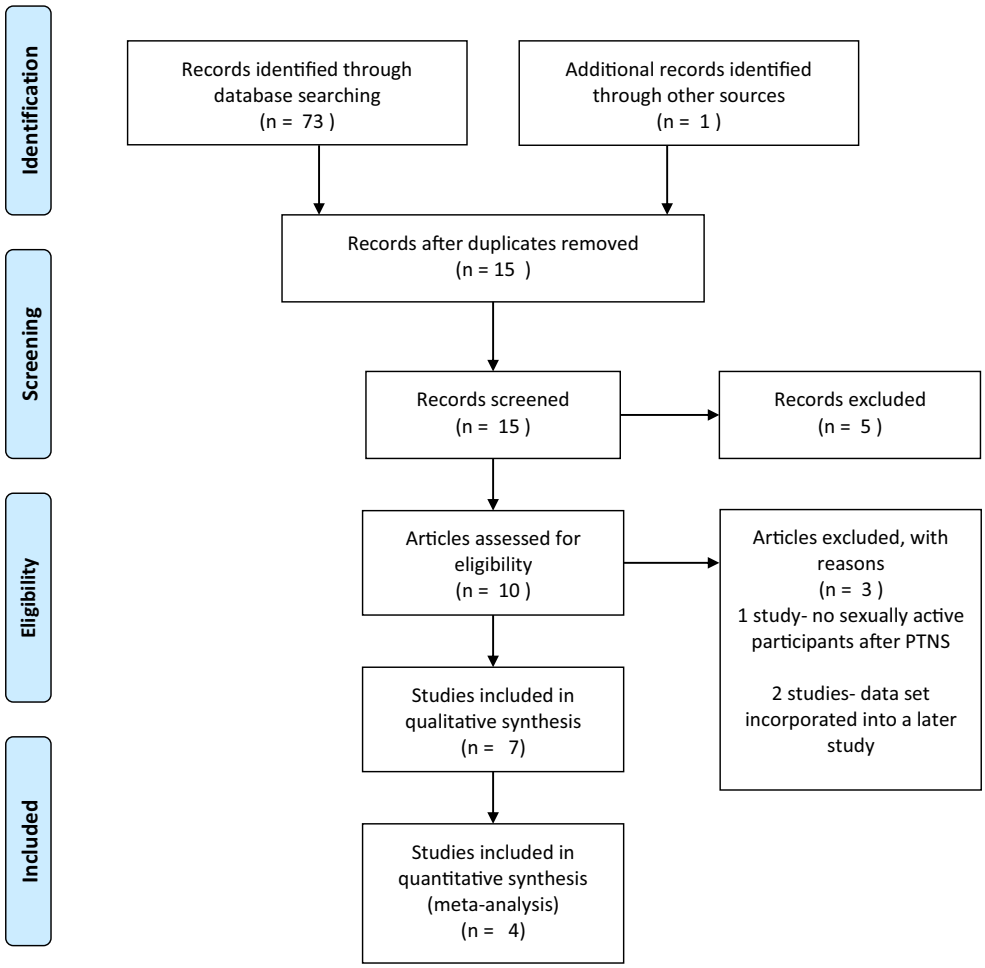

Fig. 1 PRISMA literature flow diagram

Figure 2 depicts the forest plot for the overall sexual function scores. When comparing sexual function in 52 participants without PTNS to 58 participants with PTNS, there was a statistically significant positive effect on sexual function with PTNS treatment ($p = 0.04$, SMD −0.41, CI [−0.79, −0.03], $I^2 = 0\%$). Figure 3 depicts subgroup analysis in the bowel domain of sexual function in the studies using the ePAQ-PF questionnaire. This shows that when comparing sexual function in 25 patients with PTNS treatment to 25 patients without PTNS treatment, there was also a statistically significant positive effect with PTNS treatment ($p = 0.03$, MD 17.7, CI[1.92, 33.47], $I^2 = 0\%$). There was no statistically significant difference in the other subgroup domains of sexual function in the ePAQ-PF results: urinary ($p = 0.38$, MD -7.24, CI [−23.51, 9.04], $I^2 = 0\%$), vaginal ($p = 0.55$, MD −4.01, CI [−23.64, 15.62], $I^2 = 0\%$) and dyspareunia ($p = 0.98$, MD −2.80, CI [−15.20, 9.59], $I^2 = 0\%$).

Table 2 presents the quality assessment scores of the studies. Only two studies were considered of high quality and neither of these reported sufficient data to be included in the meta-analysis.

Discussion

Our results demonstrate a positive effect of PTNS on sexual function. This effect is seen both on overall sexual function scores and in the bowel domain subgroup of sexual function.

The quality assessment tool used was not a validated instrument, which is a limitation of our methodology. None of the studies included disclosed any industry-related funding/sponsorship. It is difficult to assess publication bias as there are so few studies and significant heterogeneity. However, we believe the risk of publication bias in this case is low as there are so few studies that it is likely even a study with a negative result would be published and therefore represented in this data. Indeed, three of the seven studies in the review and two of the four studies in the meta-analysis did not find a positive effect of PTNS on sexual function.

We recognise the heterogeneity between the populations of participants (OAB, FI, double incontinence, voiding dysfunction, pelvic pain); however, we utilised a random effect model to moderate for this, and the I^2 value in the meta-analysis was 0%, indicating low excess variance and suggesting our data are likely to report a true effect. It was not possible to analyse

Table 1 Characteristics of the studies

Study	Study type	Number of participants	Mean age of participants	Pelvic floor problem	Assessment tool used	Positive effect on sexual function	P value
Musco et al. 2016*	Before-after	41	51 years	OAB	FSFI	Yes	< 0.05
Kelly et al. 2016*	Before-after	60 (15)	57 years	FI	ePAQ-PF	Yes (only in bowel domain)	< 0.01
Eftekhar et al. 2014*	RCT	50 (40)	47 years. PTNS 49 years. Control	OAB	FSFI	No	–
Craig et al. 2016*	Before-after	41 (11)	Not reported	OAB + FI	ePAQ-PF	No	–
Sand et al. 2011	RCT	220	62 years. PTNS 60 years. Control	OAB	GRA OAB-q	No	–
Bayrak et al. 2009	RCT	24	Not reported	Pelvic pain	FSFI	Yes (only in pain domain)	0.01
Van Balken et al. 2006	Before-after	76	53 years	OAB, pelvic pain, voiding dysfunction	NSF-9	Yes	< 0.005

*Studies included in meta-analysis

Abbreviations: OAB, overactive bladder; FSFI, female sexual function index; FI, faecal incontinence; ePAQ-PF, electronic personal health questionnaire-pelvic floor; RCT, randomised controlled trial; PTNS, percutaneous tibial nerve stimulation; GRA, global response assessment; OAB-q, overactive bladder quality of life questionnaire; NSF-9, nine questions regarding sexual functioning, Dutch language version

the effect on sexual function separately for those patients receiving PTNS for OAB compared with those receiving PTNS for FI as some studies contained mixed patients.

In the study by Bayrak et al. there was an improvement reported only in the pain subscale of the FSFI [22]. Given that this study involved participants receiving PTNS treatment for pelvic pain perhaps it is unsurprising that this effect was seen as the pelvic pain scores themselves also improved. This suggests that the improvement in sexual function may likely be a secondary effect in this patient group. None of the studies in the meta-analysis included patients who had PTNS primarily for pelvic pain. We feel this strengthens the reliability of our findings as whilst pelvic floor disorders share common aetiology, the pathogenesis of pelvic pain can be more complex and multifactorial. On the other hand, in the study by van Balken et al., which involved participants receiving PTNS treatment for OAB, voiding dysfunction and chronic pelvic pain, the participants that were most likely to experience a benefit in sexual function were those being treated for overactive bladder [21].

The study by Kelly et al. stated that many of the participants were either sexually inactive or declined to answer questions related to sexual domains [18]. It is therefore possible that these data are less reliable as the absence of a response in the sexual domain of the ePAQ-PF questionnaire may have falsely skewed the results against the presence of an effect of PTNS treatment on sexual function. However, the study did report a statistically significant improvement in the bowel domain of sexual function [18].

In the study by Craig et al., 15 of the 33 participants had double incontinence (both urinary and faecal), as opposed to a single pelvic floor disorder [20]. It reported a positive effect of PTNS treatment on sexual function using a before-after design [20]. However, it is arguably more likely that patients with double incontinence would report an improvement in sexual function if both their urinary and faecal symptoms reduced because of the substantially disabling nature of suffering with both conditions compared with patients with only one pelvic floor dysfunction.

It is difficult to determine from these data whether PTNS definitely improves FSD and whether the improvement is simply mediated by improving urinary and bowel symptoms, which in turn leads to an improvement in confidence and desire, or whether PTNS has a direct action on sexual function via the S3 innervation of the vagina. When considering the ePAQ-PF scores, there was a significant improvement in the bowel domain of sexual function suggesting that by improving bowel symptoms, sexual function in turn improved as a secondary effect, whereas there was no statistically significant improvement in the urinary domain of sexual function, despite an overall improvement in sexual function, perhaps suggesting a direct effect on FSD independent of urinary symptoms in this group of women.

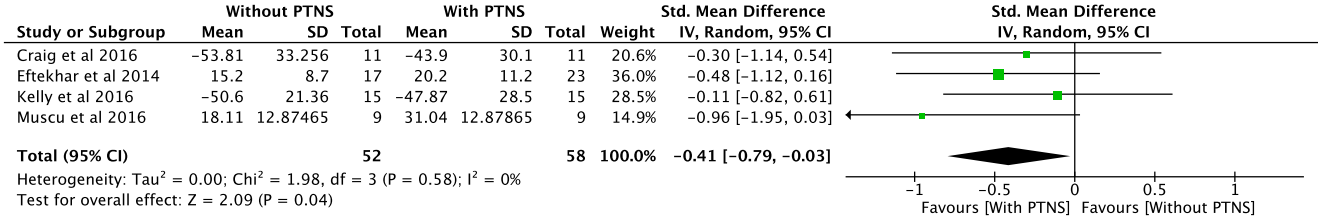

Fig. 2 Forest plot for overall sexual function scores

Furthermore, one of our studies by Musco et al. reported an improvement in both FSD and OAB symptoms with PTNS treatment but without a correlation between the FSFI scores and the OAB short-form questionnaire scores, again suggesting that this improvement in sexual function is independent of urinary symptoms [23].

Jha et al. report that in the surgical treatment of stress urinary incontinence, FSD improves post-operatively, largely because of the reduction in coital incontinence [24]. However, this improvement in FSD was only observed in those patients who also reported improvement in stress urinary incontinence symptoms and therefore appears to be a secondary effect [24]. This would perhaps be expected as the surgical methods involved in treatment of stress incontinence are theoretically unlikely to have an autonomous effect on sexual function in the absence of neuromodulation or change to vaginal architecture. Indeed, for some patients the anterior vaginal wall surgery involved in these procedures may actually result in dyspareunia [24]. It does not necessarily follow however that this would be the case in treatment of OAB symptoms, particularly as coital incontinence is a less frequent feature of the symptom complex and the pathological processes involved are often multifactorial and likely to be a combination of neurological, structural and external factors. This is in contrast to the mechanical aetiology underlying stress incontinence of urethral hypermobility and/or intrinsic sphincter deficiency. There are many studies demonstrating an improvement in sexual function following medical treatment of overactive bladder syndrome [25].

If there is hypothetically a direct effect on FSD with PTNS treatment due to neuromodulation of S3, one may expect to see a difference in the impact on sexual function following intravesical botulinum toxin, which is localised to the detrusor muscle, in comparison to sacral neuromodulation treatment and PTNS.

In 2018, Shawer et al. (presented but unpublished to date) reported a systematic review and meta-analysis of six studies examining the effect of intravesical botulinum toxin on sexual function in women undergoing treatment for overactive bladder. This showed a positive effect on sexual function in all domains of the FSFI except pain. It follows that the improvement seen in arousal, desire, orgasm and satisfaction may simply be due to improvement in urinary symptoms, leading to improved body image and confidence, which is reflected in the part played by the higher cortical component of sexual function. Therefore, it is feasible that intravesical botulinum toxin treatment would lead to an improvement in these domains. However, whilst arousal plays a part in lubrication, it is not solely responsible for the function, and so it is difficult to explain how intravesical botulinum toxin may lead to an improvement in this. It may be that the vulval irritation and soreness caused by urinary incontinence and pad use improve as the OAB is treated and in turn this leads to a recovery in vulval health and lubrication and thus a secondary effect of improvement in urinary symptoms.

Khunda et al. reported a systematic review and meta-analysis of 17 studies examining the effect of sacral neuromodulation on sexual function in women undergoing treatment for bladder or bowel dysfunction [14]. This showed that sacral neuromodulation also has a positive effect on sexual function ($p = 0.0001$, SMD –0.39, CI –0.58 to −0.19), a finding that was in line with previous reviews in this area [26–28]. The positive effect was seen in the sub-domains of arousal, satisfaction and pain, but not in lubrication or orgasm [14]. This is conflicting in terms of trying to make sense of whether there is a direct or indirect benefit. One may expect that, to see an improvement in sexual pain, there must be a direct effect on genital sensation (in the absence of a concomitant

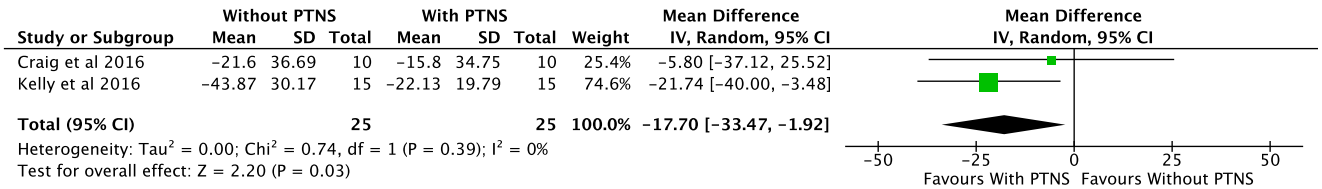

Fig. 3 Subgroup analysis in the bowel domain of sexual function using the ePAQ-PF questionnaire

Table 2 Quality assessment score of studies

Study	Study size	Sexual function tool	Follow-up time	Presence of control group	Percentage lost to follow-up	Total score
Musco et al.	0	1	1	0	1	3
Kelly et al.	0	1	1	0	1	3
Eftekhar et al.	0	1	1	1	0	3
Craig et al.	0	1	1	0	1	3
Sand et al.	1	0	1	1	1	4
Bayrak et al.	0	1	1	1	1	4
Van Balken et al.	0	0	1	0	1	2

bladder pain syndrome), and yet if there were a direct effect at play, one would also expect to see an improvement in lubrication, which was not the case. However, it may be that lubrication improves largely as a result of resolution of urinary symptoms and better vulval condition. Thus, a different population of patients may experience improvement in urinary symptoms from those that experience an improvement in sexual function. Of the 17 studies included in the systematic review, 4 studies reported on the correlation between improvement in bowel/bladder symptoms and improvement in sexual function. Of these, one study found significant correlation whilst three studies did not. This strengthens the argument that the effect of neuromodulation (PTNS or SNS) on sexual function is independent from its effect on bowel and bladder symptoms.

There is another notable difference between the effect of intravesical botulinum toxin and the effect of sacral neuromodulation in that there was an improvement in sexual pain with sacral neuromodulation that was not seen with intravesical botulinum toxin. The effect on sexual pain may be direct if the patient suffered from dyspareunia or may be secondary if the patients had chronic pelvic pain.

In our PTNS review, of the three studies that used FSFI scores, one (Musco et al.) showed a significant improvement in all domains [23], one (Eftekhar et al.) demonstrated a trend to improvement in all domains (except satisfaction) but this was not statistically significant [19], and one (Bayrak et al) showed no statistically significant difference in any of the domains except for pain [22]. This again highlights sexual pain as an area of improvement with PTNS as seen with sacral neuromodulation, further adding to the argument that these forms of neuromodulation of S2-4 may improve sexual function independent of urinary symptoms. However, this finding was not replicated in the two studies that used ePAQ-PF scores as there was no statistically significant difference in the dyspareunia domain.

There are significant limitations to our data. The number of studies is small (7 in total, 4 in meta-analysis). The studies themselves are relatively small with the number of participants ranging from 11 to 220 and all but one of the studies having < 100 participants. Furthermore, only three of the studies were RCTs and none of the studies in the meta-analysis were considered high quality according to our quality assessment tool.

When comparing RCTs (using sham PTNS or tolterodine only) with before-after studies there are mixed results. Two of the three RCTs, including the largest study in the review, did not find a positive effect of PTNS on FSD, whereas three of the four before-after studies reported a positive effect of PTNS on FSD. It may be argued therefore that it is necessary to interpret our results with caution as an RCT would generally be considered the most robust evidence.

Three of the studies included in the systematic review could not be included in the meta-analysis because of either an incomplete data set or data being reported in a non-compatible format for comparable data analysis, despite attempts to remedy this by emailing the authors.

It may be argued that if all the studies in the systematic review had been included in the meta-analysis then the results could have been different. The largest of the studies in the review by Sand et al. involved 220 patients and was one of the two RCTs, thus it is arguably the most robust of all the studies [29]. Unfortunately, the study did not report sufficient data to be included in our meta-analysis, despite attempts to contact the author, although it did report that there were no significant changes in the sexual function indices [29]. The other two studies excluded from the meta-analysis were a moderately sized before-after study by Van Balken et al. of 76 participants [21] and a small RCT by Bayrak et al. of 24 participants [22], both of which reported a positive effect on sexual function.

Our results are furthermore limited by the difficulties in accounting for confounding variables which may also affect sexual function, for example menopause. This is particularly pertinent given the mean age of participants

ranged from 47 years to 62 years, although we did use a random effect model to moderate for this as much as possible. We know that the incidence of FSD increases postmenopause with one third of premenopausal women and half of postmenopausal women affected [7]. It was not possible to analyse the data separately to compare participants < age 51 years vs. participants >51 years as we did not have access to sufficient raw data.

In our review there were insufficient studies to analyse the effect of PTNS on sexual function in patients with OAB, faecal incontinence, voiding dysfunction and pelvic pain separately, and we therefore may have missed a significant difference in the effect between these patient groups.

It may be argued that the studies in this review do not employ the most appropriate assessment tool for sexual function in this group of patients. FSFI is a validated tool for assessing female sexual function and ePAQ-PF is a validated quality of life assessment tool for global pelvic floor function (urinary, vaginal, bowel and sexual function). However, the PISQ-IR (Pelvic Organ Prolapse/Urinary Incontinence Sexual Questionnaire-IUGA revised) tool developed by IUGA (International Urogynecological Association) is the best sexual function assessment tool specifically validated for use in pelvic floor disorders [30].

FSD has a high prevalence amongst the general population in the absence of pelvic floor dysfunction, with a lifetime prevalence of 15.5% at its most conservative estimate [5]. Research is needed to assess the effect of PTNS on sexual function as a primary outcome in patients undergoing treatment for pelvic floor dysfunction. If these results show a positive effect on FSD, particularly if there is a concurrent poor correlation with improvements in urinary/bowel symptoms, there would be grounds on which to examine further the effect of PTNS on FSD in patients without associated pelvic floor dysfunction. It is also important to establish through further research the domains of sexual function in which PTNS treatment may have a positive effect. Subsequently, it may be used as a targeted therapy for specific sexual dysfunction complaints such as dyspareunia or anorgasmia. As our review has highlighted a notable association with improvement in pain following neuromodulation, it would be especially interesting to investigate the effect of neuromodulation (sacral and PTNS) in patients with vaginismus or unexplained dyspareunia. A positive finding in this patient group or in the context of a wider population of patients with primary sexual dysfunction would have considerable implications such that PTNS may earn a place in the multidisciplinary armoury required when tackling this difficult to treat, yet highly prevalent disorder. This would be particularly exciting given the recent advent of implantable PTNS devices.

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Compliance with ethical standards

Conflicts of interest Victoria Kershaw: Attended educational course sponsored by Olympus.

Aethele Khunda: Attended educational course sponsored by Olympus, received an educational travel grant from Medtronic plc and Axonics Modulation Technologies Inc.

Carol McCormick: None.

Paul Ballard: Attended educational course sponsored by Olympus.

Conference presentations

1. British Society of Urogynaecology (BSUG) Annual Scientific Meeting, Royal College of Obstetricians and Gynaecologists, London, UK, 2–3 November 2017.
2. International Urogynecological Association (IUGA) 43rd Annual Meeting, Vienna, Austria, 27–30 June 2018.

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