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Systematic review

Pelvic floor muscle training improves erectile dysfunction and premature ejaculation: a systematic review

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Abstract

Background Erectile dysfunction (ED) and premature ejaculation (PE) often have underlying musculoskeletal abnormalities. Despite this, traditional management has focused on pharmaceutical prescription.
Objective To investigate the efficacy of pelvic floor muscle training in treating ED and PE.
Data sources A computerized literature search of CINAHL®, Cochrane, InFormit, Ovid Medline, Pedro, and Scopus (from inception until January 2018) was conducted of type of dysfunction and intervention. Secondary search strategies included Medical Subject Headings expansion, hand searching of conference abstracts, key authors, reference lists and forward citation searching via Web of Science.
Study selection All studies where participants were males greater than 18 years with ED or PE, with no history of neurological injury or previous major urological surgery were included.
Study appraisal Two independent reviewers assessed methodological quality using the Crowe Critical Appraisal Tool. Disagreements between reviewers were resolved by consensus.
Results Ten trials were included for review. Among the measures of ED, all trials showed comparative improvement and cure rates in response to treatment. Within PE outcomes, the majority of trials showed comparative improvement rates, with a greater range in overall cure rates in response to treatment. Training protocols varied significantly in overall therapist contact, concurrent interventions, intervention length, training frequency and intensity.
Limitations The included studies were of low to moderate methodological quality with discrepancies in reporting. Study heterogeneity was not conducive to data pooling.
Conclusion Pelvic floor muscle training appears effective in treating ED and PE; however, no optimal training protocol has been identified.
Systematic Review Registration Number PROSPERO CRD42016047261.

Keywords: Pelvic floor; Erectile dysfunction; Premature ejaculation; Rehabilitation; Sexual dysfunction

Introduction

Male sexual dysfunction places a significant burden on the individual and is often associated with underlying psychological and cardiovascular risk factors [1–3]. It encompasses ejaculatory disorders, erectile dysfunction (ED), decreased libido and premature ejaculation (PE), and often occurs secondary to pelvic floor musculature dysfunction [4]. Of these dysfunctions, ED and PE have been identified as being as high as 52% and 30% respectively in the general male population [5].

The male pelvic floor has three roles: to support the abdominal contents; to coordinate contraction with sphincters for faeces and urine elimination; and to facilitate the erectile and ejaculatory processes [6]. Two reviews have suggested contraction of the superficial pelvic floor musculature (ischiocavernosus and bulbocavernosus) produces an increase in intracavernous pressure (thus erection), by

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Design
- Quantitative trials

Participants
- Consenting males, > 18 years old
- Erectile dysfunction OR premature ejaculation
- No previous history of prostatectomy
- No neurological deficits such as stroke, multiple sclerosis, spinal cord injury or Parkinson's disease

Intervention
- Pelvic floor muscle training

Outcome measures
- Measures of erectile function (IIEF, treatment response)
- Measures of premature ejaculation (IELT, PEDT, treatment response)

Comparisons
- Strengthening versus nothing/placebo
- Strengthening plus other therapy versus other therapy

Fig. 1. Inclusion criteria.

restricting venous drainage to the penis crura [6,7]. Further research suggests rhythmical contraction of the bulbocavernosus muscle propels semen through the urethra during the ejaculation process [8,9].

Dysfunctions in the pelvic floor musculature often occur due to a lack of activation, control, or strength [7]. Reduction in tone and alterations in contractile patterns (as identified by ultrasound) have been linked to incontinence [10,11]; and, may directly impact erectile strength and the ejaculatory process [12].

Despite a potential muscular dysfunction, traditional management of these sexual dysfunctions has consisted of lifestyle modification and pharmaceutical prescription [1,13]. Addressing the underlying pelvic floor dysfunction is something physiotherapists have long helped to manage, particularly post surgery for incontinence [14,15]. The same principles of pelvic floor muscle training (PFMT) for incontinence may be applicable to sexual dysfunction.

The purpose of this systematic review is to investigate the following:

1. Is PFMT effective in treating erectile dysfunction?
2. Is PFMT effective in treating premature ejaculation?
3. To identify an optimal PFMT protocol for both sexual dysfunctions.

Method

Design

Identification and selection of studies

The review was reported according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines [16]. The a priori submitted protocol was reviewed and published (CRD42016047261) by PROSPERO (www.crd.york.ac.uk/prospero).

The search strategy encompassed two key concepts from the research questions: dysfunction and intervention. The intervention component was further refined to pelvic floor, physiotherapy and strengthening keywords. Electronic databases CINAHL®, Cochrane, InFormit, Ovid Medline, Pedro, and Scopus were searched to January, 2018 (see Appendix 1 and 2 on the eAddenda for keywords and full search strategy in supplementary material). Search strategies included expansion via medical subject headings (MeSH), and truncation of key words. Boolean operators; "AND" and "OR" were utilised. The electronic search was supplemented by a hand search of conference abstracts; key authors; reference lists as well as forward citation searching via Web of Science. After duplicate removal; two reviewers (CM; MS) independently screened titles and abstracts of identified papers in the initial search strategy against inclusion criteria (Fig. 1). Potentially relevant trials were then retrieved for independent full text evaluation. Disagreements between reviewers were resolved by consensus.

Assessment of characteristics of studies

To reduce bias, two reviewers independently appraised the included studies for methodological rigour using the Crowe Critical Appraisal Tool (CCAT) [17]. Studies were ranked according to level of evidence as part of the Hierarchy of Evidence by the National Health and Medical Research Council [18]. Differences in opinions between the reviewers were resolved by consensus.

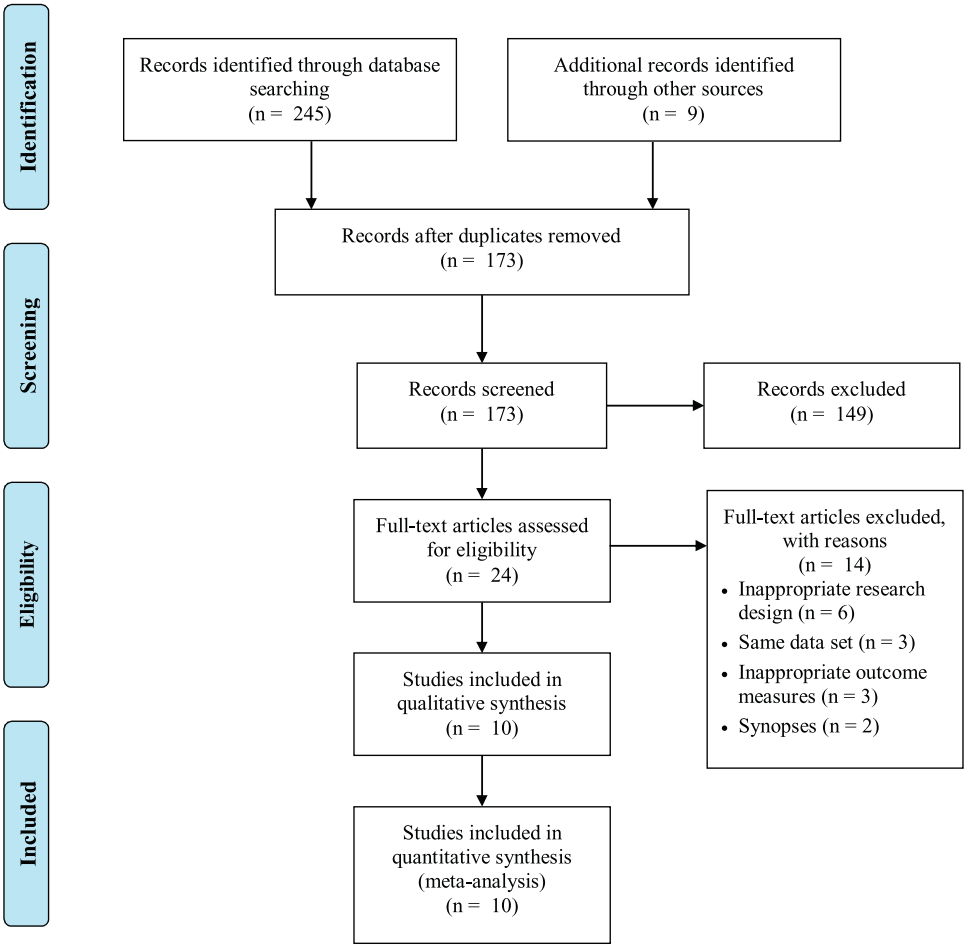

Fig. 2. Identification and selection of studies (PRISMA Flow Diagram).

Participants

Trials were eligible if participants were consenting males aged 18 years or older, diagnosed with either erectile dysfunction or premature ejaculation. Studies with participants post prostatectomy were excluded. In addition, participants with neurological deficits such as stroke, multiple sclerosis, spinal cord injury, or Parkinson's disease were also excluded.

Intervention

The experimental intervention was pelvic floor muscle training. A broad adaptation of a previously reported definition of pelvic floor muscle training was accepted as a program of repeated voluntary pelvic floor muscle contractions taught and/or supervised by a health professional [15]. Studies were included regardless of concurrent conservative interventions (i.e. biofeedback, electrical stimulation, and lifestyle changes). Frequency, intensity, duration, and concurrent therapies were reported.

Data analysis

Data was extracted by one reviewer into Microsoft Excel. Publication details, participant demographics, setting, intervention(s) – including frequency, intensity, time, and type, comparators, reported outcomes, attrition rates, and adverse effects were extracted. Results from data extraction were consolidated by a second reviewer to ensure accuracy.

Results

Flow of studies through the review

A combination of electronic and manual searching identified 254 potential studies. After duplicate removal, 173 studies were screened by title and abstract, among which, 24 were assessed in full text. Of these, ten eligible trials were identified. The flow of studies through the review and the reasons for exclusion of studies are presented in Fig. 2.

Characteristics of studies

Of the ten included trials, five trials were focused on erectile dysfunction [19–23], with the other five focused on premature ejaculation [24–28]. These included one ran-

domised controlled trial [19]; one prospective randomised trial [24]; five pre post-test studies [21–23,25,27]; one parallel study [20]; one retrospective study [28]; and, one crossover study [26].

Quality

The methodological quality of the included trials varied, with CCAT scores ranging from 23% to 85%, with a mean of 70% for the ED subgroup and 60% for the PE subgroup. Two PE-based trials were of low methodological quality scoring 23% [27] and 35% [28]. This was reflected in the significant lack of description in overall study design, results and discussion. The agreed scoring components of the CCAT of the included trials and level of evidence are presented in Table 1.

Participants

The ten trials enrolled a combined total of 668 participants, with mean ages ranging from 30 to 59 years old. The underlying causes for participants identifying as having ED included a combination of arteriogenic, hormonal, psychogenic, and venogenic causes. One study identified ED duration of greater than 6 months [19]. Within the PE subgroup, participants were identified as having either lifelong or secondary PE. No study reported on symptom duration within the participants identifying as having secondary PE.

Intervention

Of the five ED-based trials, three had no comparator [21–23], one compared surgical intervention [20], with the only randomised controlled trial comparing active lifestyle advice to PFMT (Table 2) [19]. Frequency of physiotherapist supervision of ED-based PFMT programs ranged from five to 20 sessions, with intervention lengths ranging from between 3 and 4 months. All ED-based trials employed an unsupervised, daily home exercise program.

Of the five PE-based trials, three trials had no comparator [25,27,28]; one trial compared their PFMT intervention with Dapoxetine (a selective serotonin reuptake inhibitor (SSRI)) [24]; one trial had their participants act as their own controls in comparison to Sertraline (SSRI) [26], as both a monotherapy and combined approach (Table 2). Frequency of physiotherapist supervision of PE-based PFMT programs ranged from 12 to 20 sessions, with intervention lengths ranging from between 4 and 12 weeks. Only one of the PE-based trials identified their participants as completing a home exercise program [26].

Outcome measures

Erectile dysfunction

All studies investigated erectile dysfunction via patient-reported response to treatment (complete response; partial response; failure/nil response) [19–23]. Only one trial utilised the gold standard International Index of Erectile Function (IIEF) [19,29]. Further response to treatment was measured by changes in intracavernous pressure (ICP) [20,21] and maximum anal pressure (MAP) [19,23]. One trial included a participant and partner quality of life outcome to further support data triangulation [19]. Two trials identified long-term follow-up of 12 months [20,21]; one trial identified a 6 months follow-up period [19].

Premature ejaculation

Four trials investigated premature ejaculation via patient-reported response to treatment (cured; improvement; failure/nil response) [24,25,27,28]. Three trials used the intravaginal ejaculatory latency time (IELT) outcome [24–26], with one further study using this within a subgroup of their participants [28]. The premature ejaculation diagnostic tool (PEDT) was also reported in the same trial [28], but lacked explicit reporting within both their results and discussion. Three trials reported no follow-up period [24,26,28]; one a 6 months follow-up period [25]; and one a follow-up period varied between 6 and 14 months [27].

Effect of intervention

Erectile dysfunction

Two trials focused solely on PFMT [20,23]; one with PFMT and biofeedback [19]; and two with PFMT, biofeedback and electrical stimulation [21,22]. Therapist supervision varied between five and twenty sessions between a 3 and 4 months intervention period. Intensity of pelvic floor muscle contractions were similar throughout all studies, encouraging maximal (short) contractions of one second, and submaximal (long) contractions of between six and ten seconds. All ED-based trials included daily pelvic floor exercises; all failed to report patient adherence to respective PFMT home exercise programs.

Patient reported cure rates (i.e. no further instances of erectile dysfunction) ranged between 35% [23], and 47% [20,22]. One trial identified significant results with the erectile function domain of the IIEF ($p < 0.05$) [19]. Treatment response was further supported by post intervention increases in both ICP and MAP (outcomes reported in Table 2) [19–21,23].

Premature ejaculation

All trials included electrical stimulation as part of their PFMT protocol. Four trials incorporated biofeedback in addition to their electrical stimulation [24,25,27,28]. Therapist supervision varied between 12 and 20 sessions between a 4 weeks and 3 months period. One trial reported on both work-rest ratios and intensity of contractions [26], with two further trials identifying work-rest ratios within their electrical stimulation parameters [27,28]. Only one trial included home-based PFMT with additional daily exercise [26]; however, failed to identify patient adherence.

Treatment response identified cure rates (i.e. able to postpone the moment of ejaculation), as ranging between 55%

Table 1
Quality of included trials (CCAT scores).

Study	Focus	Preliminaries	Introduction	Design	Sampling	Data collection	Ethical matters	Results	Discussion	Total (/40)	Total (%)	NHMRC evidence level
Claes & Baert (1993) [20]	ED	4	5	2	2	2	2	4	3	24	60	IV
Claes et al. (1995) [21]	ED	4	5	3	3	3	2	4	3	27	68	IV
Dorey et al. (2004) [19]	ED	5	5	4	5	5	2	4	4	34	85	II
Mohammed et al. (2015) [23]	ED	4	5	2	3	4	2	4	2	26	65	IV
Van Kampen et al. (2003) [22]	ED	4	5	3	3	4	1	4	4	28	70	IV
Kurkar et al. (2015) [26]	PE	4	5	3	2	3	4	4	4	29	73	III-3
La Pera (2014) [28]	PE	3	3	2	2	1	0	1	2	14	35	IV
La Pera & Nicastro (1996) [27]	PE	3	2	1	1	0	0	1	1	9	23	IV
Pastore et al. (2014) [25]	PE	4	4	2	3	4	4	5	4	30	75	IV
Pastore et al. (2012) [24]	PE	5	5	3	3	4	4	5	4	33	83	III-3

ED = erectile dysfunction; NHMRC = National Health and Medical Research Council; PE = premature ejaculation.

Table 2
Summary of included studies (n = 10).

Study	Participants	Intervention	Primary outcome	Results
Claes & Baert (1993) [20]	Men with ED PFMT = 78 Surgery = 72 (11 dropouts)	4 months intervention PFMT (therapist-led + HEP) >5 sessions	ICP; treatment response	47% at base; 34% at tip; cured: 46%; improved: 28%; unchanged: 26%
Claes et al. (1995) [21]	Men with ED N = 122 (14 dropouts)	4 months intervention PFMT (therapist-led + HEP), biofeedback >20 sessions	ICP; treatment response	(mild ED group: median 52% at base; 38% at tip); (moderate ED group: 46% at base; 37% at tip); Cured: 36.1%; improved: 34%; unchanged: 30%
Dorey et al. (2004) [19]	Men with ED PFMT = 28 Con = 27 (22 dropouts)	3 months intervention PFMT = PFMT (therapist-led + HEP), biofeedback 5 sessions Con = active lifestyle advice	IIEF; treatment response	Cured: 40%; improved: 35%; unchanged: 25% ($p < 0.05$)
Mohammed et al. (2015) [23]	Men with ED N = 40 (4 dropouts)	4 months intervention PFMT (therapist-led + HEP) 16 sessions	Treatment response	Cured: 35%; improved: 40%; unchanged: 25% ($p < 0.01$)
Van Kampen et al. (2003) [22]	Men with ED N = 51 (9 dropouts)	4 months intervention PFMT (therapist-led + HEP), biofeedback, e-stim 16 sessions	Treatment response	Cured: 47%; improved: 24%; unchanged: 12%; dropouts: 17%
Kurkar et al. (2015) [26]	Men with PE N = 74	8 weeks intervention PFMT (therapist-led + HEP), e-stim 12 sessions	IELT	Mean (SD): 175s (46) ($p < 0.05$)
La Pera (2014) [28]	Men with PE N = 78	3 months intervention PFMT (therapist-led), biofeedback, e-stim 20 sessions	IELT; PEDT; treatment response	>10 minutes; Cured: 55%; unchanged: 45%
La Pera & Nicastro (1996) [27]	Men with PE N = 18	20 sessions intervention PFMT (therapist-led), biofeedback, e-stim 20 sessions	Treatment response	Cured: 61%; improved: 11%; unchanged: 28%
Pastore et al. (2014) [25]	Men with PE N = 40 (2 dropouts)	12 weeks intervention PFMT, e-stim 36 sessions	IELT; treatment response	Mean (SD): 146s (38); Cured: 83%; improved: 5%; unchanged: 12% ($p < 0.05$)
Pastore et al. (2012) [24]	Men with PE PFMT = 19 SSRI = 21 (2 dropouts)	12 weeks intervention PFMT (therapist-led), e-stim 36 sessions	IELT; treatment response	Mean (SD): 126s (37); Cured: 58%; improved: 11%; unchanged: 26%; dropouts: 5% ($p < 0.05$)

Con = control group; ED = erectile dysfunction; e-stim = electrical stimulation; HEP = home exercise program; ICP = intracavernosal pressure; IELT = intravaginal ejaculatory latency time; IIEF = international index of erectile function; PE = premature ejaculation; PEDT = premature ejaculation diagnostic tool; PFMT = pelvic floor muscle training group; SD = standard deviation; SSRI selective serotonin reuptake inhibitor group; Surgery = surgery intervention group.

[28], and 83% [25]. Intravaginal ejaculatory latency time also increased significantly within three studies ($p < 0.05$) (outcomes reported in Table 2) [24–26].

Discussion

This was the first systematic review to consider PFMT as a primary intervention for the conservative management of ED and PE. All trials included within the review identified PFMT as being effective in the management of these sexual dysfunctions. However, significant heterogeneity and methodological limitations (such as study design, reporting methods, and PFMT protocols) were present in the majority of trials. Trial protocols varied with respect to therapist contact, patient education, concurrent interventions, intervention length, training frequency and intensity.

Intervention prescription

Current recommendations for pelvic floor muscle strength training are between two and three sessions weekly [30]. All PE-based trials adhered to this recommendation with the exception of one trial, who included daily PFMT exercises post-therapist intervention [26]. Post intervention intravaginal ejaculatory latency times from this trial were just as significant when compared to two other trials ($p < 0.05$) [24–26].

Equally important as training frequency, contraction intensity is required for increasing overall muscle hypertrophy [31,32]. A combination of maximal (short) and submaximal (long) contractions allows for targeted recruitment of the differing skeletal muscle fibres of the pelvic floor [32,33]. In turn, this allows for the sustained tone required for an erection, as well as the short powerful contractions and reflexive responses necessary for ejaculation [12,15].

The addition of electrical stimulation may increase the rate, intensity and synchronization of motor unit firing [34]. Through additional motor unit recruitment and altered frequency of firing, corrected patterns of contraction of the bulbocavernosus muscle can occur, allowing greater conscious control of the ejaculatory process [11,15].

However, in this review, responses to treatment either with or without electrical stimulation were actually quite similar. Cure rates varied from between 36% to 47% and 35% to 46% for ED-based trials with and without electrical stimulation respectively. Further high-quality studies investigating the effectiveness of PFMT versus PFMT plus electrical stimulation are therefore warranted within the ED population.

Provision of feedback

There was no consistent approach to the provision of verbal and physical feedback to patients across the trials. Two ED-based and three PE-based trials taught pelvic floor muscular awareness via a combination of verbal and physical feedback achieving statistically significant results ($p < 0.05$) [19,23,24–26]. By comparison, three ED-based trials were unclear on the degree of verbal feedback, favouring physical feedback without significant results [20–22]. This is consistent with current literature that suggests varied efficacy when using physical feedback (biofeedback) [33].

The nature of verbal feedback is also important. Careful verbal instruction is effective in pelvic floor activation [35]; with differences in verbal cueing being shown to alter the pattern of activation in pelvic floor musculature [36]. With a distinct lack of protocol description in the majority of trials in this review, it is difficult to draw informed conclusions about respective protocol efficacies. As such, further research with is warranted to establish whether a combination approach to feedback is required and to determine the optimum feedback method for clinical practice.

Therapist intervention

The amount of therapist intervention varied across studies and was considerably lower in the ED trials compared to the PE trials. This in part, may be due to the ED studies optimizing the use of independent home based programs. Within the PE trials, variability was high in terms of the number of therapist led sessions. Further exploration is required to determine the optimum patient–therapist interaction time and when care can effectively be transferred to home based exercise programs.

Limitations of the review

Whilst the search strategy was comprehensive, potential limitations for this review must be acknowledged. Literature outside of searched databases may exist, in languages other than English. Of the identified literature, mixed study designs and overall quality was variable. Many studies had incomplete reporting, particularly with key information regarding their methodology, sampling and the progression of PFMT protocols. This discrepancy in reporting translated into many studies failing to report the following: measure of central tendency and dispersion (i.e. mean and standard deviation); mean differences; odds ratios; power calculations; and, lack of raw data.

Implications for practice

This review highlights the role PFMT has in managing ED and PE. Pelvic floor muscle training appears beneficial despite the absence of reporting on many aspects of the respective protocols. For those favouring a noninvasive approach, PFMT provides a potential first line management option. It is acknowledged that ED and PE often have underlying pathologies; therefore, investigations into identifying such causes is recommended.

Identifying the optimal combination of education and feedback tailored to the patient should be considered by

the clinician. Ensuring correct contraction through early (bio)feedback is important and may limit the number of therapist-led interventions if a patient adheres to a prescribed home exercise program. Pelvic floor muscle training programs should follow current strengthening guidelines in consideration of the individual, ensuring the key components of overloading and training specificity are applied. Supplementary biofeedback and electrical stimulation may be beneficial; however, recommendations for these cannot be made stronger due to the heterogeneity of intervention protocols. For individuals wanting a short-term treatment, a combination approach of PFMT and oral pharmacological agents may be considered for both sexual dysfunctions [19,26].

Recommendations for future research

Given the heterogeneity between training protocols and supplementary management options, further research into the benefits of PFMT in isolation is appropriate given the potential invasiveness of the additional tools, as well as the associated financial costs. Greater description of protocol reporting (e.g. included as online supplementary material or appendices) would allow for more detailed evaluation and comparison in identifying the most effective protocol components.

An important consideration of successful intervention is the number of therapist interventions and patient adherence. The paucity of detail on patient adherence of home based programs warrants greater description of reporting in future trials. Further to this, identification of a minimum number of therapist-led interventions to effect significant change within each sexual dysfunction would better direct future legislation and funding of public health services.

Key messages

- First systematic review to examine the role of pelvic floor muscle training in the treatment of erectile dysfunction and premature ejaculation in a non-neurological, non- post surgical male population.
- Pelvic floor muscle training with or without supplemental intervention appears effective in treating both erectile dysfunction and premature ejaculation.

Declarations of interest: None declared.

Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at https://doi.org/10.1016/j.physio.2019.01.002.

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