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A systematic review of supervised comprehensive functional physiotherapy after radical prostatectomy

Une revue systématique des interventions de kinésithérapie fonctionnelle holistique supervisée après prostatectomie

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1 **Introduction**

2 Prostate cancer is the second most frequently diagnosed cancer in the world, and one of the leading
3 causes of cancer-related death in men [1, 2]. Radical prostatectomy (RP) is one of the reference
4 treatments for men with a life expectancy of over 10 years and suffering from localized cancer of
5 intermediate risks, to control disease progression and prevent metastasis [3]. Life expectancy beyond
6 the surgery may reach over 20 years [4]. If the long-term prognosis is encouraging, living as a RP
7 survivor added to the overall impact of tumor disease involves significant multiple adaptation
8 challenges. Whatever the operative modality (robot-assisted or open approach), this condition can
9 generate multidimensional physiological changes (physical functions and abilities, emotional and
10 sexual functioning, sleeping disorders, fatigue, pain) [5-9]. This may restrict their participation in daily
11 life and led to social isolation, for example because of fear linked to urine control and/or poor body
12 image, and/or decrease in physical capacities [10-13]. These alterations may fade away over time, but
13 nearly 50% of patients still have a significant decrease of their health related quality of life (HRQOL)
14 5 years after after RP [14, 15]. The World Health Organization's model (WHO-ICF) highlight the
15 interaction of the multiple components of each individual and the potential links between the patient's
16 context, personal and environmental factors, structural and functional impairments, activity limitations
17 and participation restrictions that can impact their HRQOL [16]. Consequently, the treatment decision-
18 making process must take into account all the aspects of disease during and following treatment [17].
19 Regardless of operative modality, UI evolves favorably most often after surgery. Nevertheless, after
20 12 month follow-up, UI defined by no change pad in 24 h was 10 to 20%, and defined by no
21 pads/3days and an absence of any leakage 41 to 58% [18, 19]. For those patients, pelvic floor muscle
22 training (PFMT) is commonly recommended as conservative treatment. PFMT has been introduced
23 into male UI after RP due to its favorable efficacy on female stress UI. However, the effects of PFMT
24 as a mono-therapy for post-RP UI remains conflicting [20-23]. The multidimensional nature of post-
25 operative side effects may requires having a more holistic approach for patients in a longer term goal.
26 For example, in a conference paper, Walke et al. showed pre-operative differences related to body
27 balance control, grip strength and dynamic reaction time, in favor of continent patients compared to

28 incontinent patients after PR (p=0.047)[24]. Some authors think physiotherapy programs should not
29 focus only on the side effect of continence, but also on the interaction of continence disorders with all
30 the other side effects related to the physical and emotional functioning. They argue that more
31 comprehensive interventions than PFMT alone, such as physiotherapy promoting general
32 coordination, flexibility, strength, endurance, fitness and functional capacity could seem more relevant
33 and patient-centered [25, 26]. Additionally, good adherence and less discomfort (not associated with
34 intra-anal devices or digital palpation) were identified as additional potential benefits of such programs
35 with equivalent results as PFMT [27]. Thus, our aim was to assess the effectiveness of more
36 comprehensive functional physiotherapy (CFPT) in post-RP patients. We therefore carry out a review
37 of the literature which assesses the effectiveness of supervised multimodal physiotherapy
38 interventions, on physical functioning (including objectively and subjectively measured UI), emotional
39 functioning and HRQOL in post-RP patients.

40

41 **Evidence acquisition**

42 This systematic review was conducted in accordance with the PRISMA (Preferred Reporting Items for
43 Systematic Reviews and Meta-Analyzes) guidelines (Appendix 1) [28].

44 *Search Strategy*

45 Two reviewers (GK, MC) searched for relevant articles from inception to January 2022 via four
46 electronic databases: PubMed, PEDro (Physiotherapy Evidence Database), Web of Science and
47 Cochrane Library (see appendix 2). The search terms included “prostatectomy”, “urinary
48 incontinence”, “urination”, “physical therapy modalities” and “rehabilitation”. Initial searches
49 included no limitation by date or language.

50 *Eligibility Criteria*

51 Inclusion criteria: studies dealing with physical therapy after RP were considered for inclusion.
52 Eligibility criteria were computed according to the PICOS model: (P), patients with prostate cancer,
53 undergoing RP, without treatment implementation as androgen deprivation therapy and/or radiation
54 therapy; (I), Intervention including supervised physical therapy programs, target on supervised

55 multimodal physical physiotherapy focusing on lower limb and lumbo-pelvic regions. They also had
56 to contain exercises promoting the following skills: relaxation skills (e.g. progressive muscle
57 relaxation or breathing exercises), flexibility (mobilization or stretching), coordination (e.g. motor
58 control or balance), strength and endurance (e.g. weight-bearing or elastic band exercises), specific
59 aerobic capacities (e.g. walking or machine based) and cognitive abilities (e.g. movement learning
60 with progressive complexity), with or without specific pelvic floor muscles (PFMs) or striated urethral
61 sphincter exercises [29, 30]. Studies based solely on PFMT were excluded from our study. (C),
62 Comparison: outcomes were analyzed versus no treatment, or isolated PFMT, or as comparison
63 between continent and incontinent patients. (O), Outcomes: feasibility was assessed by attrition rate
64 and adverse events. Efficacy was evaluated by objectively measured physical outcomes : pad testing
65 (1-hour/24-hours)(primary outcome), PFMs functions (sEMG recordings or perineometry), physical
66 fitness (e.g. spiroergometry test protocol on a treadmill), coordination, strength and endurance (e.g.
67 isokinetic dynamometer), balance (e.g. balance test using force platform), functional capacity (e.g. 6-
68 minute walking test, sit up), and subjectively measured outcomes: patient reported continence status
69 (frequency or leakage, number of daily pads), physical functions, satisfaction, HRQOL and physical
70 activity levels measured by validated questionnaires. Outcomes were assessed at short-term (≤ 3
71 months after training completion), intermediate-term (3-6 months), and long-term (6 months or more).
72 (S) Study design: randomized controlled trials (RCT), or partially randomised patient preference trial
73 (PRPPT), or prospective cohort studies dealing with multimodal physiotherapy program after RP.
74 Based on eligibility criteria, data and study characteristics were independently extracted by two
75 reviewers (MC, BS). Disagreements were resolved by consensus and cross-checked by MG.

76 *Data extraction*

77 On the basis of titles and abstracts, two reviewers (MC, BS) independently screened and successively
78 selected articles according to their title and abstract. Based on the CONSORT (Consolidated Standards
79 of Reporting Trials) checklist [31], the following information were extracted : (I) Type of study,
80 author information and its publication date (II); Eligibility criteria of each study (III); Details of the
81 study design (number of patients randomized, method of randomization, length of observation, biases

82 of each study including PEDro score); (IV) Data relating to outcomes of interest; (V) Details of the
83 interventions used. For data deemed not appropriate for synthesis, a narrative overview was
84 conducted.

85

86 *Results analysis*

87 All studies reporting the above-mentioned results were pooled and analyzed. To determine if a
88 technique was effective, we extracted the p-value. For each test, the significance level was .05. When
89 available, we extracted the odd ratio (OR) of each included study. Less than one, it is considered as a
90 protective factor, unlike a value greater than one indicates a risk factor.

91 *Quality assessment*

92 The methodological quality of the included studies was assessed by three independent authors (MC,
93 BS and MG). We assess the internal validity (methodological quality) with the PEDro scale which is
94 widely used in physiotherapy and assist readers to quickly assess whether a clinical trial presents
95 reliable and meaningful results for use in clinical practice [32-33]. Currently, the number of articles
96 dealing with comprehensive rehabilitation programs after radical prostatectomy is still limited, so we
97 defined a relatively flexible PEDro cut-off score of ≤ 4 for inclusion in our review to promote openness
98 and discussion, in accordance with Albanese E et al. [34].

99 *Levels of evidence*

100 According to the quality of selected studies, levels of evidence were given [35-37]. The quality of the
101 body of evidence on a specific outcome is based on 5 domains: limitations in the design and
102 implementation (risk of bias), inconsistency (heterogeneity), indirectness (inability to generalize),
103 imprecision (insufficient or imprecise data) and publication bias (See appendix 3). High quality level
104 can be assigned if the results of several high-quality RCTs are consistent. Moderate quality level can
105 be assigned in case of consistent findings among multiple moderate or low-quality RCTs and/or one
106 high-quality RCT. Low quality of evidence is reported if the available studies are questionable from a
107 methodological point of view or their results are not consistent overall. Conflicting evidence means

108 inconsistent findings among multiple trials. These level of evidence are useful to guide therapist in
109 their professional practice.

110

111 **Evidence synthesis**

112 Initial search yielded 561 records after deduplication. 484 were excluded and 15 were assessed for
113 eligibility because they did satisfy the inclusion criterias. 7 articles were excluded due to a PEDro
114 score <4. Finally, 8 papers were included in the present review (Figure 1). Two of the included studies
115 were conducted in Korea [38, 39], two in Germany [40, 41], one in Poland [42] and one in Canada
116 [43], two originated from the same department in Brazil [44, 45]. The data on this topic are quite
117 recent considering that all studies were published in the past eight years (2012-2020). Five were RCTs
118 [38,41-45], two were PRPPTs [40], and one was a prospective observational study of a post-RP
119 population during CFPT intervention [39].

120 *Quality assessment*

121 According to the PEDro score, all the studies selected for the review were of moderate to high
122 methodological quality (Table 1). The overall quality assessment scores ranged from 4 to 9, with a
123 median (first quartile ; 3th quartile) score of 6,6 (4.75 ; 8.5). One study failed to report complete
124 outcome data [40]. Two studies validated included subject blinding, therapist blinding and selective
125 reporting [44, 45]. The methodological quality and the heterogeneity of the studies included did not
126 allow for an additional meta-analysis to be performed.

127 *Participants & interventions*

128 The mean number of participants per trial was 88.8 (range 49-184), resulting in an overall sample size
129 of 711 men (mean age 65.7). For each intervention there were one to five sessions a week, with a
130 median length of follow-up of 22.6 weeks. Intervention for five of the studies combined CFPT +
131 PFMT [38-42], and for the three remaining studies CFPT without PFMT [43-45]. Two studies
132 compared CFPT to no treatment [44, 45] and one compared CFPT to PFMT [43]. One study compared
133 continent patients to non-continent patients after combined therapy [39] (Table 2). Outcomes were
134 assessed at completion of the physiotherapy intervention for 7 studies. This means 6-12 weeks for five

135 studies [38, 39, 41, 44, 45], 10-15 months for two studies [40, 42]. For Au et al., all outcomes were
136 measured at 2, 6, 12, and 26-weeks post-RP [43].

137 *Primary outcome: objectively measured urinary incontinence.*

138 Regarding objectively measured urinary incontinence (pad test), all the studies reported significant
139 positive outcomes for CFPT between pre/post-intervention. In inter-group analysis, four studies
140 evaluated CFPT intervention versus no treatment: two with high level and one with moderate level
141 reported significant positive outcomes [40, 44, 45]. One with moderate level suggested a moderate but
142 no significant mean difference (MD) on UI (MD=-0.23 (95% CI -5.03 to 4.57), p=0.922)[40]
143 between pre/post-intervention. In inter-group analysis, five studies evaluated CFPT intervention versus
144 PFMT alone. Two studies with high level and one with moderate level reported significant positive
145 results of CFPT intervention versus PFMT for UI [38, 41, 43], and two studies with high level
146 reported inter-group differences between pre/post-intervention in favor of CFPT, but not significant :
147 Pedriali et al. reported a percentage of improvement weight reduction in the 24 hr pad test of 89.77%
148 in CFPT versus 75.35% in PFMT group. and that 57.7% of the patients in CFPT and 50% from PFMT
149 no longer used pads [44]. Gomes et al. reported improvements in the 24 h pad test from 198.79 ±
150 223.38 to 85.85 ± 180.60 grams in CFPT, and from 177.40 ± 216.48 to 67.4 ± 131.88 in PFMT group,
151 and that 59% of patients in CFPT, and 54% in PFMT no longer used pads [45]. No study reports
152 superior results of PFMT compared to CFPT.

153 *Secondary outcomes: objectively measured physical capacities and functions.*

154 Park SW et al. reported that balance ability were more improved in the exercise group than in control
155 (p=0.015), but not hand grip strength (p=0.494) and body composition (fat mass (p=0.353), skeletal
156 muscle mass (p=0.263), body mass index (p=0.514), or waist/hip ratio (p=0.586))[38]. In Zopf et al.
157 study, within-group pre/post intervention sensitive analysis yielded positive results for VO² peak in
158 favor of intervention group versus control (IG=3.19 versus CG=-1.00 (95% CI 0.73 to 0.77),
159 p=0.018)[40]. Park J et al. reported that changes in the hip extensor muscle strength during the
160 exercise program were significantly associated with continence status after the 12-week exercise
161 program (OR 1.029, (95% CI 1.001 to 1.080), p=0.010)[39]. Rajowska-Labon et al. found

162 improvement in PFMs velocity for continent versus incontinent patients after intervention
163 ($p=0.03$)[42]. Gomes et al. reported no inter-group difference for PFM power ($p=0.09$), strength
164 ($p=0.07$), or endurance ($p=0.11$) for PFMs after intervention [45]. In multivariate analysis, Park J et al.
165 reported no significant differences for maximal urethral closure pressure between continent and non-
166 continent patients at the end of the intervention (OR 0.097 (95% CI 0.992 to -1.103), $p=0.097$)[39].

167 *Secondary outcomes: subjectively measured urinary incontinence, emotional functioning and health*
168 *related quality of life.*

169 Four studies evaluated the effectiveness of CFPT on UI through ICIQ-SF with positive results: three
170 versus no treatment [42, 44, 45], and one for combined therapy versus PFMT alone [38]. Zopf et al
171 reported that results of the EORTC-QLQ-PR25 showed a group difference in favor of the CFPT in the
172 urinary symptom score ($p=0.027$)[40]. Au et al. study found significant positive results for the
173 frequency of leakage in favor of CFPT vs PFMT alone (IG= 0.94 ± 0.28 versus CG= 2.07 ± 0.57 ; RR 0.45
174 (95% CI 0.22 to 0.98), $p<0.05$)[43].

175 Four of the selected studies reported data for emotional functioning. In Park SW et al. study, the
176 mental composite score of the SF-36 improved in CFPT group ($p=0.017$) but not in control
177 ($p=0.773$)[38]. Zopf et al. reported positive effects pre/post intervention on emotional and social
178 functioning ($p=0.020$, and $p=0.003$ respectively)[40]. In Heidenreich et al. study, a sub-group analysis
179 reported that early continence recovery will result in an improvement of HRQL and increased patient's
180 satisfaction ($p<0.001$)[41]. In Au et al. study, emotional well-being yielded positive results for CFTP
181 versus PFMT alone (MD= $0.24 \pm 1.17/-2.07$, $p<0.02$)[43].

182 Five of the eight selected studies yielded enough satisfactory HRQoLs data for a relevant report [38,
183 41, 43-45]. In one study, the physical composite score of the SF-36 was back to the pre-operative level
184 with CFPT ($p<0.001$) but not in control ($p=0.225$), and the mental composite score of the SF-36
185 improved in CFPT ($p=0.017$) but not in control ($p=0.773$)[38]. In one study, ICIQ-SF inter-group
186 analysis demonstrated differences in post-treatment HRQoL scores favoring CFPT compared to no
187 treatment ($p<0.05$) (Data not presented)[45]. One study evaluated HRQoL through EORTC with
188 positive significant improvements in physical role ($p<0.001$ and $p<0.001$ respectively) within the

189 CFPT, when only role and social functioning improved in the no-treatment group ($p=0.002$ and
190 $p=0.015$, respectively)[40]. One study reported that improvement for HRQL was higher in the CFPT
191 compared to PFMT after three weeks of treatment ($p=0.017$)[41]. One study noticed contrasting
192 results for HRQOL depending on the questionnaire: Mean difference for FACT-G reached 5.26 ± 3.31
193 -1.29 ($p=0.11$), and for PORPUS only reached $2.83 \pm 3.61 -4.31$ ($p=0.9$)[43] (Table 3).

194

195 **Discussion**

196 In view of the multidimensional side effects after prostatectomy surgery found in recent literature, the
197 objective of this review was to gather and then assess the effectiveness of studies offering a more
198 holistic physiotherapy than PFMT alone, in a patient-centered approach. Till today, PFMT was only
199 compared to biofeedback, electric stimulation, lifestyle changes, or inactive treatment. However, the
200 effects of PFMT in mono-therapy on post-surgery UI remains conflicting [20-23]. To our knowledge,
201 this is the first review providing data that would help to further compared more comprehensive
202 supervised physiotherapy treatment versus PFMT in post-RP patients.

203 *Quality assessment*

204 The median of the combined quality check scores was 6.6, suggesting that the quality of the studies
205 reviewed was moderate. Four RCTs were distinguished by PEDro scored 8-9 [41, 43, 44, 45].
206 However, five of the selected lacked of intention-to-treat analysis [38, 39, 42, 44, 45]. Partially
207 randomised patient preference trial design, as a more comprehensive cohort trial, was chosen for two
208 studies for ethical reasons. In one of them, subgroups were made up with respect to some patients not
209 agreeing to have an anal probe fitted for exercises [42]. In the other study, recruitment was challenging
210 due to the long intervention period and the distance from the recruitment department [40]. We kept
211 one prospective observational cohort study due to its robust design and appropriate results. This study
212 assessed maximal urethral closure pressure with an urethral catheter, which seems more relevant for
213 continence function than PFMs strength, but the results should be interpreted with caution because
214 continent patients are defined by pad-free status [39]. Regarding bias of indirectness (inability to
215 generalize), heterogeneity of assessment and treatment modalities appeared between studies.

216 *Level of evidence for UI*

217 Regarding UI, all the studies reported positive outcomes for CFPT between pre/post-intervention. Five
218 studies evaluated CFPT intervention versus PFMT alone: among them three reported positive results
219 of CFPT versus PFMT alone for UI: Park SW et al., 2012; Heydenreich M et al., 2020 and Au D et
220 al., 2020 [38, 41, 43]. The first was of moderate quality level and the other two were of high quality
221 level. Two other studies with high quality level reported no inter-group differences: Pedriali FR et al.,
222 2016 and Gomes CS et al., 2018 [44, 45]. Five studies, four with high level and one with moderate
223 level, assessed UI through subjective patient reported outcome, all with positive results in favor of
224 CFPT [38, 40, 42, 44, 45]. This combination of four high-quality studies with consistent finding for
225 volume of leakage, the results of which are corroborated by those of several moderate quality level
226 studies, enable us to attribute a high level of evidence to the effectiveness of CFPT on UI, objectively
227 (pad testing) or subjectively measured (questionnaire).

228 *Level of evidence for physical capacities and functions*

229 Four of the selected studies concentrated on physical capacities and functions [38-40, 43]. Some
230 general physical functions were increased in two studies [38, 40]. Some physical capacities were
231 increased in four studies. One study of moderate level reported more positive effects for CFPT on
232 strength, endurance, balance ability of lower limb or lumbo-pelvic muscles [38]. One study of high
233 quality level reported positive but non significant result on functional and physical well-being [43].
234 One study reported that changes in the hip extensor muscle strength were found to be significant
235 variables for forecasting continence status at completion of the CFPT [39]. The result of those
236 moderate/high quality level studies underlines the fact that CFPT could result in more positive
237 physical outcomes than PFMT alone. This enabled us to assign a moderate level of evidence for the
238 effectiveness of CFPT on physical capacities and functions.

239 *Level of evidence for emotional functioning*

240 Four of the selected studies reported data for emotional functioning with positive results on mental
241 composite score [38], emotional, and social functioning [40], patient's satisfaction [41] and emotional
242 well-being [43]. None of the studies reported negative effects of CFPT on any emotional functioning

243 outcomes. Considering the two high quality level studies but the incomplete result on the different
244 aspects of emotional functioning, we can assess a moderate level of evidence for the effectiveness of
245 CFPT on emotional functioning.

246 *Level of evidence for HRQoL*

247 Three studies of high to moderate quality level yielded positive results for HRQoL: one of moderate
248 level for physical, mental composite scores [38], one of moderate level for role, emotional, social
249 functioning [40], and one of high quality level for general HRQoL [45]. Two studies of high quality
250 level yielded contrasting results [41, 43]. These results lead us to assign a moderate level of evidence
251 for the effectiveness of CFPT on HRQoL (Table 4).

252 *Complementary results*

253 CFTP was shown to be safe [38-40, 43] and non-invasive [42-45]. Rajkowska-Labon et al., with a
254 sensori-motor control training program, reported more positive differences in PFMs neuromuscular
255 response time in favour of continent patients at completion of the CFPT program, while no differences
256 were observed for PFMs strength and relaxation [42]. Gomes et al. reported no inter-group difference
257 for PFMs power, strength, or endurance after intervention, and no strong correlations between the
258 improvements in PFMS parameters and 24 h pad test [45]. Park J. et al. reported no meaningful
259 change in maximal urethral closure pressure between pre and post-CFPT program, 12 weeks after RP,
260 comparing the continent and incontinent group [39]. So the question of PFMT based solely on
261 voluntary contraction of PFMs versus specific involuntary pelvic and trunk muscles co-activations
262 remains controversial [21, 41].

263 *Modalities of HFTP program*

264 All the studies were provided by trained interventionists. Most of them experimented with
265 interventions starting at 2-3 weeks post surgery. CFPT sessions were found to range from 30 to 60
266 minutes. Training intensities were supervised and adjusted individually based on the patient's
267 condition and experience [38-40, 42, 43]. The duration of physical therapy programs was very
268 heterogeneous, ranging from 3 weeks [40] up to 12 or 15 months [40, 42-45]. Most interventions
269 promote general coordination, flexibility, strength, endurance, fitness and functional capacity. CFPT

270 exercises were provided using tools such as Swiss balls, Pilates balls, elastic bands, flexible rods,
271 machine based, or unstable surfaces (eg; foam surfaces). Sensori-motor control training program
272 focusing on reflexive activity of pelvic floor and deep abdominal musculature were the main focus of
273 five studies [41, 42, 43, 44, 45]. Aerobic exercises were implemented in three of the selected studies
274 [38-40]. Thanks to the positive effects on motivation, adherence, emotional and social functioning,
275 group therapy was implemented in all the studies. Home-based exercise sessions were suggested and
276 encouraged in five of the studies [40, 42, 43-45]. There was a modest dropout rate in the treatment and
277 control groups [38, 39]. The results in Heydenreich et al. were outstanding regarding the efficient ratio
278 between the results and the short duration of both sessions (30mn) and intervention (3 weeks) [41].
279 We highlight the study from Park SW et al. because substantial benefits were seen in dynamic
280 parameters such as flexibility and balance, while fat mass and body mass index parameters did not
281 change [38]. Those positive results of CFPT on physical capacities and functions are in accordance
282 with the general recommendations for men after cancer promoting physical activities [46]. In
283 conclusion, interventions promoting general coordination, flexibility, strength, endurance, fitness and
284 functional capacity was shown to be safe, non-invasive, and particularly effective in terms of UI
285 recovery (moderate level of evidence), but also in terms of physical capacities and functions
286 improvement (moderate level of evidence), in terms of emotional functioning (low level of evidence),
287 and in terms of quality of life (moderate level of evidence), after interventions. According to the
288 WHO-ICF model, the treatment decision-making process must take into account all the aspects of the
289 burden of disease during and following treatment. So, we can suggest that health professionals must
290 be trained to master and deliver evidence-based CFPT treatment programs. CFPTs using structured
291 supervised programs could be implemented safely in a range of nonmedical settings as first-line
292 physical therapy approach for post-surgery UI.

293 *Strengths and bias*

294 To our knowledge, this is the first review focusing on the effectiveness of supervised CFPT on UI,
295 physical capacities and functions, emotional functioning and HRQOL in post-RP patients. The
296 methodology of this review was consistent with the PRISMA recommendations. We agree that design

297 is certainly a limitation. Two of our selected studies were no RCT for ethical reasons. PRPPT design,
298 as a more comprehensive cohort trial, was chosen over a conventional RCT design. In one of them,
299 subgroups were made up with respect to some patients not agreeing to have an anal probe fitted for
300 exercises [42]. In the other case, recruitment was challenging due to the long intervention period and
301 the distance from the recruitment department [40]. However, patients' preference led to a substantial
302 proportion of a specific patient group refusing randomisation, while it seems not influence the primary
303 outcome within an PRPPT [46]. One of our selected study was a prospective observational design, but
304 nevertheless a pre-post CFPT intervention study [39]. The design of this study led us to emphasize that
305 hip muscle strength can be a significant predictor of continence status. Our systematic review
306 confirmed that the broad diversity in measurement instruments, cure rate definitions, and intervention
307 outcomes presents a challenge for synthesizing results. Most of our selected studies exclude associated
308 pathologies that may cause a functional disorder, which excludes this bias in the interpretation of our
309 results. Although not enough studies can be used for meta-analysis, the conclusion should be regarded
310 as preliminary. Nevertheless, the wide variety of countries (external validity) represented in the
311 included studies with consistent results suggests a reproducible effectiveness of CFPT in different
312 socio-cultural, ethnical or religious environments (Table 2). As such, the results displayed here can be
313 considered a resource for more focused research, to further confirm whether CFPT speeds up UI
314 recovery and presents advantages in terms of physical and emotional functioning, and in terms of
315 HRQoL.

316

317 **Conclusion**

318 Based on available literature, physiotherapy promoting general coordination, flexibility, strength,
319 endurance, fitness and functional capacity was shown to be safe, non-invasive, and particularly
320 effective in terms of UI recovery. CFPT could result in more positive outcomes, in terms of physical
321 capacities and functions improvement, in terms of emotional functioning, and in terms of quality of
322 life, after interventions. Most of the studies included in the review experimented with group
323 supervised interventions starting at 2 or 3 weeks post-surgery, with 30 to 60 minute-sessions and

324 lasting 10 to 12 weeks. Home-based exercise sessions were suggested and encouraged. Nevertheless,
325 the heterogeneity of methodologies and of the CFPT programs themselves makes it difficult to
326 generalize the results. On the other side, the wide variety of countries represented in the included
327 studies with consistent results suggests a reproducible effectiveness of CFPT in different socio-
328 cultural, ethnical or religious environments. Further standardized and well-designed clinical trials
329 conducted by experienced multidisciplinary clinicians are still called for.

330

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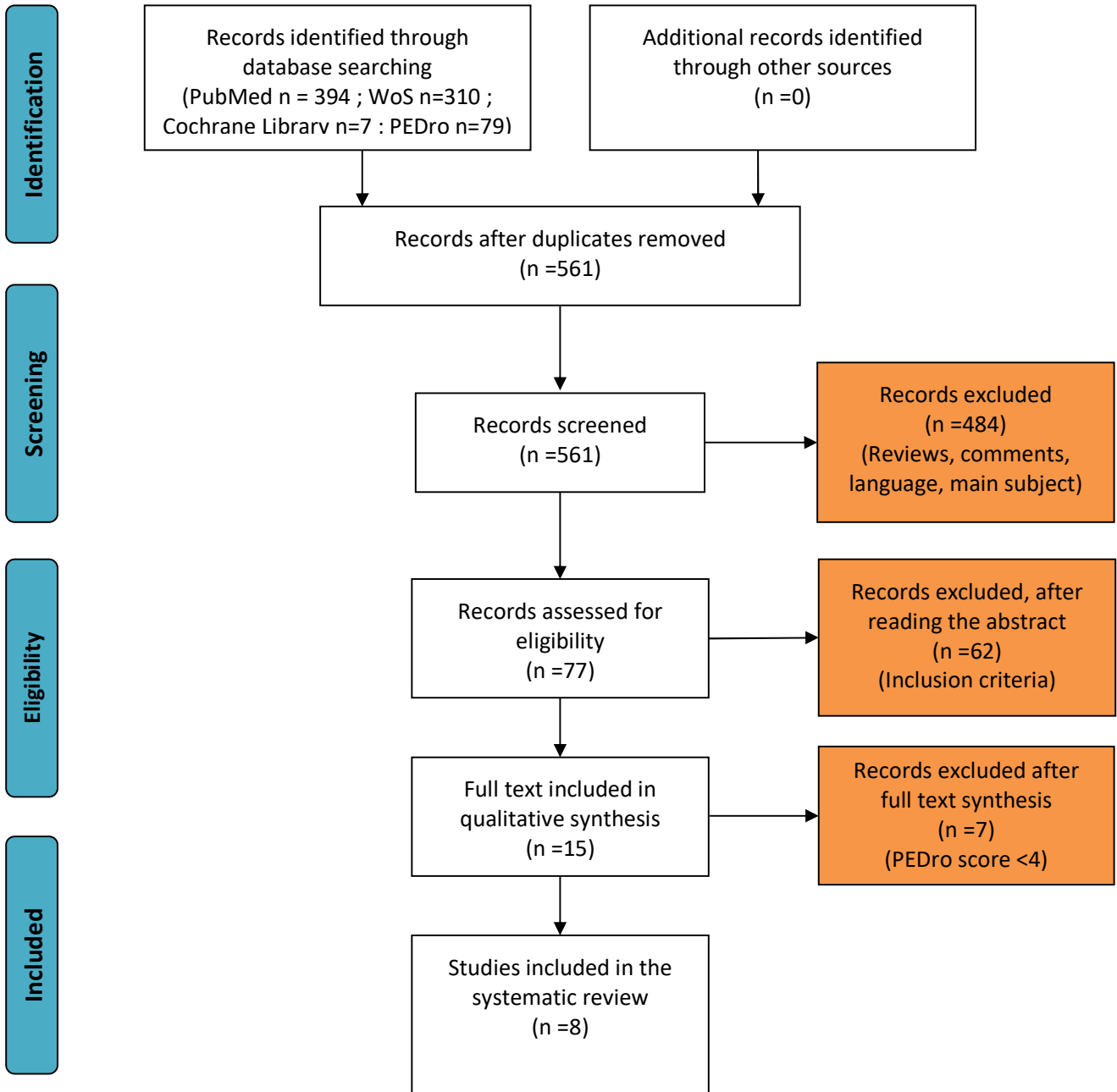
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Table 1: Details of PEDro scores and quality level of each study selected for the review.

Studies	1	2	3	4	5	6	7	8	9	10	11	Scores	Level Quality
Park SW. et al., 2012	✓	✓	✓	✓	✗	✗	✓	✗	✗	✓	✗	5/10	A Moderate
Rajkowska-Labon et al., 2014	✓	✗	✗	✓	✗	✗	✓	✓	✗	✓	✗	4/10	A Moderate
Zopf et al., 2015	✓	✗	✗	✓	✗	✗	✓	✓	✓	✓	✓	6/10	A Moderate
Pedriali et al., 2016	✓	✓	✓	✓	✓	✓	✓	✓	✗	✓	✓	9/10	B High
Park J. et al., 2018	✓	✗	✗	✓	✗	✗	✓	✓	✗	✓	✗	4/10	B Moderate
Gomes et al., 2018	✓	✓	✓	✓	✓	✓	✓	✓	✗	✓	✓	9/10	B High
Heidenreich et al., 2020	✓	✓	✓	✓	✗	✗	✓	✓	✓	✓	✓	8/10	A High
Au et al., 2020	✓	✓	✓	✓	✗	✗	✓	✓	✓	✓	✓	8/10	A High

According to the PEDro scale (Maher CG et al. 2003), the items correspond to: 1 Inclusion criteria and source, 2 Random allocation, 3 Concealed allocation, 4 Baseline comparability, 5 Blinding of all subjects, 6 Blinding of all therapists, 7 Blinding of all assessors, 8 Completeness of follow up, 9 Intention-to-treat analysis, 10 Between-group statistical comparisons for at least one key outcome, 11 Both point measures and measures of variability for at least one key outcome

Table 2 : The main characteristics of the selected studies

Study	Design	Participants/Eligible criteria	Intervention	Outcomes and assessment tools (Inter group pre-post physiotherapy)
Park SW et al., 2012 S.Korea	RCT	N=49. Mean age, IG :69.1±5.7 CG :69.4±7.2 years BMI : IG :24.2±4.1 CG :23.8±3.6 EC : men ≥ 65; ECOG≤1; diagnosed with PCa undergoing RP; no adjuvant therapy, pelvic surgery, cardiovascular or rheumatology diseases.	Implementation: 1-4 weeks post-RP Duration : 12 weeks, sessions 60min, twice/week - IG (n=23) : Pelvic & lower limb flexibility, strength and endurance training with elastic band + swiss ball + PFMT - CG (n=26) : PFMT	IA : Pre-surgery FA : 12 weeks post-intervention <u>Physical capacities/Physical functions:</u> - Muscular strength and endurance - Functional tests : (e.g. sit-ups, grip strength) - Flexibility : ASLR test, sit-and-reach test - Balance : Body sway with force platform <u>Continence:</u> 24h-pad test; ICIQ-SF <u>Quality of life:</u> SF-36 ; Mental component : BDI
Rajkowska-Labon et al., 2014 Polland	PRPPT	N=81 Mean age, IG : 66.9 ± 7.07 CG :68.3 ± 6.49 years EC : diagnosed with PCa undergoing RP; no artificial pacemaker; musculoskeletal disease; LUTS, polyuria; uncontrolled diabetes mellitus; neurologic conditions; previous PFMT	Implementation: 1 to 12 weeks post-RP Duration ≤12 months, sessions 20/60min, weekly - IG (n=49) 1)PFMT +/- BFB; 2)Lumbo-pelvic stabilization training; 3) home training (3X/week 20min) - CG (n=32) no treatment, no instruction	IA : Before intervention FA : After intervention (≤12 months) <u>Continence:</u> - 1h-pad test / 24h-pad test - 4 days micturition diaries <u>PFM functions:</u> - Strength, relaxation, velocity (sEMG (μV))
Zopf et al. 2015 Germany	PRPPT	N=85 Mean age , IG :64.21 ± 6.13 CG :65.17 ± 5.54 years BMI, IG :26.62 ± 3.32 CG :27.03 ± 3.51 EC : diagnosed with PCa undergoing RP or combined therapy; no hormone treatment or chemotherapy; metastatic, cardiac or chronic disease; mental illness; exercised regularly (>1 hour/week)	Implementation: 6-12 weeks post-RP Duration : 15 months, sessions 60min, weekly - IG (n=56) : exercises and games that promote flexibility, coordination, relaxation, cognitive abilities, interaction, cooperation, and communication + PFMT + aerobic - CG (n=29) : no treatment, no instruction	IA : Before intervention FA : 15 months post-intervention <u>Aerobic fitness:</u> spiroergometry on treadmill (VO ₂ peak) <u>Health Related Quality of life:</u> EORTC QLQ-C30-PR25 <u>Erectile function:</u> IIEF <u>Physical activity level :</u> Freiburger Questionnaire of Physical Activity
Pedriali et al., 2016 Brazil	RCT	N=85 Mean age, G1 :66.07±5.77 G2 :66.32±5.48 G3 (CG) : 62.61±7.26 years EC: no preoperatively UI; no previous TURP; no neurological or cognitive impairment; no LUTS; no anticholinergic treatment	Implementation: 4 weeks post-RP Duration : 10 weeks, Session : 45 min, weekly - Gp 1 (n=26): 1)Pilates, 2)Home training - Gp 2 (n=28): PFMT, 2)ES 3)home training - Gp 3 (n=31): no treatment, no instruction	IA : Before intervention FA : 10 weeks post-intervention <u>Continence:</u> - 3 days bladder diary/24h-pad test - ICIQ-SF - Daily pads usage
Park J et al., 2018 S. Korea	nRCT	N=53 Mean age : G1 :68.2±6.1 G2 :68.3±5.1 years BMI : G1 : 24.8±2.8 G2 :26.6±9.0 EC : men≥65; ECOG≤1; diagnosed with PCa undergoing RP; no adjuvant therapy or severe postoperative complications; no history of pelvic surgery or LUTS; no diseases that could affect the exercise program	Implementation: 2 weeks post-RP Duration : 12 weeks, 2 weeks post-RP, session 60min - Session 1 (6 weeks) : PFMT - Session 2 (6 weeks) : Pelvic & lower limb flexibility, strength and endurance training with elastic band	IA : Pre-surgery FA : 12 weeks post-intervention G1: continent 31 patients / G2: incontinent 22 patients <u>Continence:</u> - Urodynamics before RP and 12 weeks post-RP <u>Physical capacities:</u> - Isocinetic test before RP and 12 weeks post-RP
Gomes et al., 2018 Brazil	RCT	N= 104 Mean age, G1 :66.62±5.66 G2 :65.83±5.64 G3 :63.11±7.19years EC : men 50/75; no previous treatment for IU; no cardiac pacemaker implant; no cognitive impairment, neurological diseases, or acute musculoskeletal disorders.	Implementation: 4 weeks post-RP Duration : 10 weeks, Session : 45 min, weekly - Gp 1 (n=34): 1)Pilates, 2)home training - Gp 2 (n=35): PFMT, 2)ESF, 3)Home training - Gp 3 (n=35): no treatment, no instruction	IA : Before intervention FA : 10 weeks post-intervention <u>Continence:</u> - Voiding diary/24h-pad test - ICIQ-SF - Daily pads usage <u>PFM functions:</u> - Perineometry (strength, endurance, power (hPa))

Heydenreich et al. 2020 Germany	RCT	N=184 Mean age, IG :64.0±6.5 CG : 64.3±7.4 years BMI, IG :27.4±3.3 CG :27.0±3.5 EC : diagnosed with PCa undergoing RP; post-RP UI: 1-200 g urine loss/1-hour pad test; normal operative and postoperative course; unable to do physical training; PFMT prior to surgery	Implementation: ≥4 weeks Duration : 3 weeks, sessions : 30min, daily - IG (n=93) : 1)PFMT 2)Coordination training for the pelvic floor muscle using an oscillating rod - CG(n=91) : 1)PFMT 2)Relaxation	IA : Before intervention FA : 10 weeks post-intervention <u>Continence:</u> - 1h-pad test / 24h-pad test <u>Health Related Quality of life :</u> - FACT-P
Au et al. 2020 Canada	RCT	N=50 Mean age : IG :63.0±8.5 CG : 61.3±7.3years BMI : IG : 26.8 ±3.7 CG : 28.2±4.4 EC : Men 40/80; diagnosed with PCa undergoing RP; no autoimmune/connective tissue disorder; no chronic pulmonary or neurological disease; no history of inguinal herniation or uncontrolled hypertension; no preexisting UI; no formal PFMT experience	Implementation: Catheter removal post-surgery Duration : 12 weeks, sessions: 45min, weekly G1 (n=25): 1)PFMT 2)Pfilates 3)Hypopressives G2 (n=25): 1)Supervised PFM home training	IA : Before intervention FA : 2, 6, 12, and 26 weeks post-RP <u>Continence:</u> - 3 days bladder diary/24h-pad test - ICIQ-SF - Frequency of leakage <u>Health Related Quality of life :</u> - FACT-G - PORPUS

Abréviations : RCT : Randomized Control Trial ; PRPPT : Partially randomized control trial ; nRCT : Not randomized control trial ; EC : Eligible criteria ; BMI : Body Mass Index ; ECOG : Eastern Cooperative Oncology Group ; RP : Radical Prostatectomy ; IG : Intervention group ; CG : Control group ; PFMT : Pelvic Floor Muscle Training ; PFM : Pelvic Floor Muscles ; ES : Electric Stimulation ; BFB : Biofeedback ; LUTS : Lower Urinary Tracts Infection ; UI : Urinary Incontinence ; IA : Initial Assessment ; FA : Final Assessment ; BDI : Beck Depression Inventory ; EORTC QLQ-C30 :European Organisation for Research and Treatment of Cancer Quality of Life Questionnaire ; PR25 : PCa-specific module ; IIEF : International Index of Erectile Function ; ICIQ-SF : International Consultation on Incontinence Questionnaire Short Form ; FACT-P : Functional Assessment of Cancer Therapy-Prostate ; FACT-G : Functional Assessment of Cancer Therapy-General ; PORPUS : Patient-Oriented Prostate Utility Score

Table 3: Summary results of studies for the different studied outcomes pre/post intervention

Study and level	Population	Interventions	Comparison	Outcomes pre/post intervention (Inter-group)		P value
	Number/Mean age			Significant	Not significant	
Park SW et al., 2012 Level B	n=49 IG: 69.1±5.7years CG :69.4±7.2years	CFPT + PFMT	PFMT	24h pad test/ICIQ-SF Physical fitness Flexibility & balance ability	Grip strength Body composition HRQoL (SF-36)	p<0.05 (IU-pad test) p<0.05 (IU-ICIQ-SF) p<0.05 (Physical fitness)
Rajkowska-Labon E et al., 2014 Level B	n=81 IG :66.9±7.07years CG : 68.8±6.59 years	CFPT + PFMT	No treatment	Number of CP 1h and 24h pad test PFM parameters (velocity)	PFM parameters (strength, relaxation)	p=0.0001 [OR, IG=0.15 vs CG=2.06] (IU-pad test) p=0.03 (PFM velocity CP vs IP)
Zopf E et al., 2015 Level B	n=85 IG :64.21±6.13 years CG :65.17±5.54years	CFPT + PFMT	No treatment	VO ² peak (+8,5%) Social function	PSA 20mn Pad test QoL	p<0.042 (UI-pad test) p<0.027(IU-EORTC) p<0.008 (Social function-EORTC)
Pedriali FR et al., 2016 Level B	n=85 G1: 66.07±5.77years G2 :66.32±5.48years G3 :62.61±7.26years	CFPT (G1)	PFMT (G2) No treatment (G3)	24h pad test (G1/G3) ICIQ-SF (G1/G3)	24h pad test (G1/G2) ICIQ-SF (G1/G2)	p<0.05 (IU-G1/G3) (IU-pad test) p>0.05 (IU- G1/G2) p=0.007 (ICIQ-SF-G1/G3) p>0.05 (ICIQ-SF-G1/G2)
Park J et al., 2018 Level B	n=53 CP :68.2±6.1years IP :68.3±5.1years	CFPT + PFMT	CP vs IP	1h pad test Isocinetic	MUCP	Continence=58.5% (31/53) p > 0.05 (MUCP) P=0.045 (Isocinetic : hip extensor strength)
Gomes CS et al., 2018 Level B	n=104 G1 :66.62 ± 5.66 years G2 :65.83 ± 5.64years G3 :63.11 ± 7.19 years	CFPT (G1)	PFMT (G2) No treatment (G3)	24h pad test (G1/G3) ICIQ-SF (G1/G3)	24h pad test (G1/G2) PFM parameters (strength, power, endurance)	p<0.05 (IU-G1/G3) (IU-pad test) p>0.05 (IU- G1/G2) p<0.05 (ICIQ-SF-G1/G3) p>0.05 (ICIQ-SF-G1/G2) p>0.05 (PFM parameters-G1/G2)
Heidenreich et al., 2020 Level A	n=184 IG :64.0(6.5)years CG :64.3(7.4) years	CFPT + PFMT	PFMT + Relaxation	1h and 24h pad test HRQoL (FACT-P) Patient's satisfaction	*	p=0.008 (IU-1h pad test) p= 0.012 (IU-24h pad test) p=0.017 (HRQoL)
Au et al., 2020 Level A	n=70 IG :63.0±8.5years CG :61.3 ± 7.3years	CFPT	PFMT	Frequency of leakage HRQoL (FACT-G)	24h pad test HRQoL (PORPUS) Erectile function (IIEF)	p<0.05 [OR 0.45] (IU-frequency) p>0.05 [OR 0.44] (IU-pad test) p=0.11[MD 5.26] (HRQoL)

Abbreviations: CFPT: Comprehensive Functional Physical Therapy; PFM: Pelvic Floor Muscle; PFMT: Pelvic Floor Muscle Training; IG: Intervention Group; CG: Control Group; CP: Continent Patients; IP: Incontinent Patients; ICIQ-SF: International Consultation Incontinence Questionnaire Short Form; VO² peak: Peak Oxygen Uptake; MUCP: Maximal Urethral Closure Pressure; HRQoL: Health Related Quality of Life; SF-36: Short Form Health Survey; FACT-P: Functional Assessment of Cancer Therapy-Prostate; FACT-G: Functional Assessment of Cancer Therapy-General ; IIEF: International Index of Erectile Function OR : Odd Ratio ; MD : Mean Difference. p-value in green are significant.

Table 4: Suggested level of evidence for CFPT

Outcomes	Urinary Incontinence <ul style="list-style-type: none"> • Objectively measured UI • Subjectively measured UI 	Physical capacities Physical functions	Emotional functioning	Health Related Quality Of Life
Suggested level of evidence	High	Moderate	Moderate	Moderate
CFPT may start 2-3 weeks post-surgery - Sessions duration 30/60 min – Lasting 10-12 weeks Training intensities were supervised and adjusted individually based on the patient’s condition and experience				