Influence of physical rehabilitation on functional aspects in individuals submitted to total hip arthroplasty: a systematic review

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Abstract

Objective: by performing a systematic review, the present study aimed to evaluate the influence of physical rehabilitation on functionality, range of motion and musculoskeletal strength in patients submitted to total hip arthroplasty due to osteoarthritis. *Methods:* a systematic search for randomized and non-randomized controlled trials was conducted using the PubMed, Web of Science, PEDro, Cochrane, Clinical Trials and SciELO electronic databases, using the search strategies recommended by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA). *Results:* in general, protocols supervised by physiotherapists associated with performing active exercises of the hip periarticular muscles and knee extensors have provided effective functional prognosis. High intensity resistance exercises (dynamic and isometric) are more effective in improving functionality. Dynamic exercises with three to five sets of eight to twelve low and high intensity repetitions promoted more pronounced increases in muscle strength and range of motion than other therapeutic modalities. *Conclusions:* the techniques and protocols used for physical therapy treatment after THA are wide-ranging and their clinical efficacy is demonstrated in literature.

Keywords: Arthroplasty, Replacement, Hip. Osteoarthritis. Exercise. Aging.

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INTRODUCTION

Population aging is a phenomenon found in several countries[1], hugely impacting the organization of health systems, as older adults are more likely to be affected by chronic diseases[2].

In this scenario, osteoarthritis (OA) is one of the main causes of functional disability in older adults worldwide[3]. The condition is characterized by structural changes, ranging from mild to severe, of the cartilage in the synovial joints[3], which occur due to biomechanical, sex, genetic, obesity, ageing, and metabolic factors[4]. Clinically, subjects with OA may experience pain, short-term stiffness, crackling, reduced joint function and deformities[3].

Weight-bearing joints, such as the knee and hip, are often affected by OA[3], and hip osteoarthritis is one of the most disabling forms of the disease[4]. Currently, surgical treatment is recommended for patients with OA who have not achieved satisfactory results with a more conservative treatment approach, and who present pain, loss of functionality, and the inability to perform activities of daily living[5].

In this sense, OA represents the clinical condition for which total hip arthroplasty (THA) is most frequently recommended. Although it is a radical procedure, THA improves quality of life and provides an early return to activities of daily living[5]. Considering the clinical and functional repercussions of OA and THA, physiotherapy becomes extremely important for patients, as it aims to increase range of motion, minimize complications resulting from the surgical procedure, provide an early return to routine activities, and improve pain and functional deficits[6,7].

Studies have shown that patients who participate in physical therapy treatment after THA exhibit a greater recovery of physical function and an earlier improvement in quality of life than those who do not[6,8-18]. Although physical therapy presents many therapeutic techniques for the post-surgical rehabilitation of these individuals, information on the efficacy of treatment protocols remains incipient.

Therefore, it is necessary to systematize the scientific evidence of adequate physiotherapy methods for the functional rehabilitation of patients undergoing THA. Based on the existing literature, the purpose of the present study is to describe the effects of physical rehabilitation on functionality, muscle strength, and range of motion in patients undergoing THA due to OA.

METHODS

This study is a systematic review which applied the following inclusion criteria: randomized and non-randomized clinical trials that evaluated protocols with physical exercises and/or electrotherapy for the treatment of subjects (female and male) undergoing THA due to osteoarthritis, compared to other forms of intervention or to a control group, and which were published in scientific journals between January 1980 and December 2019. The exclusion criteria were: studies that did not meet the inclusion criteria, systematic reviews, case studies, case series, retrospective studies, observational studies, pilot studies and experimental animal model studies.

The systematic search for randomized and non-randomized controlled trials was performed using the PubMed, Web of Science, PEDro, Cochrane, Clinical Trials and SciELO electronic databases, based on the search strategies recommended by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA). The search was also performed by screening the citations of the studies included in the review. The research used the following Medical Subject Headings Terms (MeSH) combined descriptors: Exercise, Hip and Arthroplasty; Physical Therapy, Hip and Arthroplasty; Physical Activity, Hip and Arthroplasty; Exercise Therapy, Hip and Arthroplasty.

The research was carried out in December of 2019. First, the titles and abstracts of all the articles identified with the search strategy were evaluated independently and in duplicate by two reviewers. All abstracts that did not provide enough information on the inclusion and exclusion criteria were selected for reading in their entirety. In the second step, the same reviewers evaluated the complete manuscripts, independently and in duplicate, to select those that complied with the eligibility criteria. Differences between reviewers were resolved by consensus among all the researchers involved.

The evaluators performed data extraction independently, using standardized forms, which included information on the authors, year of publication, participants (number of individuals, age and sex), study design, evaluation scale, duration of the study, and intervention results. In case of inconsistency, the original documents were retrieved and investigated together for consensual definition. The outcomes of interest were: muscular strength; range of motion (ROM); functionality.

The risk of bias in the evaluation and methodology was analyzed by the same independent reviewers and in duplicate, using the JADAD bias risk scale[24]. For each specific outcome, the quality of the evidence was based on five factors: 1-described as randomized, 2-described as double-blind, 3-description of sample losses, 4-appropriate randomization, and 5-appropriate masking. The JADAD scale results are divided into two levels of evidence that classify the study as low (score 0 to 2) or high quality (score 3 to 5)[19].

RESULTS

A total of 5702 studies were found by electronic search; 5264 of which were excluded as neither pre-established eligibility nor inclusion criteria were matched. Therefore, 438 were selected for detailed analysis, beginning with the titles; 321 were excluded due to being duplicates. Thus, 117 abstracts were evaluated, 57 of which were selected for reading in their entirety. After the evaluation of the full text, 26 articles were excluded as they did not comply with the eligibility criteria. Thus, 31 studies were included in the systematic review. Subsequently, the studies cited by the 31 papers included in the review were analysed, with one study which had not been identified being included in the present review. Therefore, 32 studies made up this systematic review.

Figure 1 shows the steps of the selection process of the studies and the reasons for exclusion.

Table 1 shows the characteristics of the studies included in this review, exhibiting the following items: author, year of publication, study design, study subjects, division of groups, analyzed variables and results.

Risks of bias

Regarding the risk of bias in the studies included in this systematic review, 29 (90.62%) studies were submitted to randomization, only two studies (6.25%) were double-blind and 29 (90.62%) reported sample losses (Table 2).

According to the JADAD score, only one study[20] received a maximum score and two articles did not score the minimum[21,22]. The classifications of the other studies are described in Table 2.

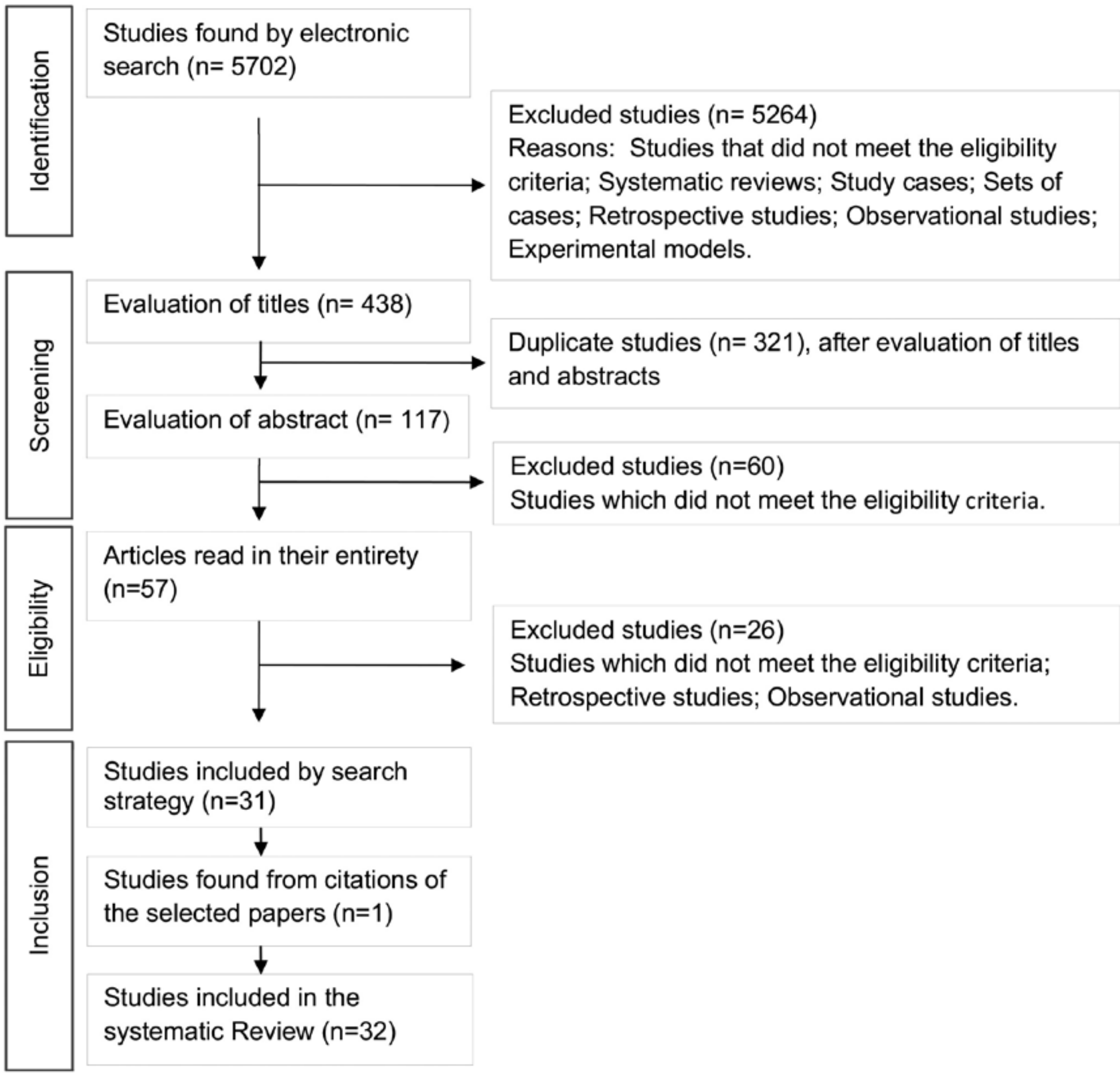

Figure 1. Flowchart of the search process, selection steps and reasons for exclusion of studies included in the systematic review. Campo Grande, Mato Grosso do Sul, 2019.

Table 1. Characteristics and results of randomized and nonrandomized clinical trials included in the systematic review. Campo Grande, Mato Grosso do Sul, 2019.

Author, year	Design and Subjects	Intervention Group (IG)	Control Group (CG)	Analyzed variables	Results
Gremeaux et al., 2008[8]	Randomized Clinical Trial n=29	LFEMS Group (Low frequency electric muscle stimulation and Physical Therapy) (n=16)	Physical Therapy Only (n=13)	Maximum isometric muscular strength of knee extensors (*isokinetic dynamometer)* and functionality (*FIM*).	The IG showed better knee extensor strength (*p*<0.05) and functionality (*p*<0.05) results than the control group.
Liebs et al., 2012[13]	Multicenter Randomized Clinical Trial n=271	THA early group (Early aquatic therapy starting on 6th postoperative day) (n=129)	THA group (Aquatic therapy after healing) (n=142)	Functionality (*WOMAC* and *Lequesne*).	The IG achieved better results for functionality (*p*=0.01).

to be continued

Continuation of Table 1

Author, year	Design and Subjects	Intervention Group (IG)	Control Group (CG)	Analyzed variables	Results
Hesse et al., 2003[14]	Randomized Clinical Trial n=79	Treatment group (conventional physical therapy and treadmill training) (n=39)	Conventional physical therapy alone (n=40)	Functionality (*HHS*) and hip abductor strength (*MRC*).	The IG had better results for functionality (*p*<0.0001) and hip abductors strength (*p*<0.001) than the CG.
Husby et al., 2010[41]	Randomized Clinical Trial n=24	STG group (Maximal strength training and conventional rehabilitation program) (n=12)	CRG group conventional rehabilitation (n=12)	Knee extensors strength (*1RM*), hip abductors strength (*1RM*), and functionality (*Merle d'Aubigné and Postel*).	STG group showed a significant increase in quadricep (*p*<0.002) and hip abductor (*p*<0.002) strength than the CG.
Heiberg et al., 2012[10]	Clinical Trial Randomized n=68	Walking skill training group (n=35)	CG(n=33)	Functionality (*FIM* and *HHS*), hip flexion, extension, and abduction ROM (Goniometer)	The IG achieved significant improvement in hip extension ROM (*p*=0.02) and functionality (*p*=0.001) when compared to the CG.
Jan et al., 2004[17]	Clinical Trial n=53	Exercise-high (Conventional exercises at home - group with high adherence) (n=13) Exercise-low (Conventional exercises at home - group with low adherence) (n=13)	CG(n=27)	Hip flexors and extensors strength (*isokinetic dynamometer*) and functionality (*HHS*).	The Exercise-high group showed improvement (*p*<0.05) of hip muscles strength bilaterally and functionality.
Trudelle-Jackson and Smith, 2004[11]	Randomized Clinical trial n=34	Experimental group (strength and postural stability exercises). (n=18)	Isometric and active range of motion exercises (n=16)	Functionality (*12-Item Hip Questionnaire*) and muscular strength of knee extensors and flexors, and hip extensors, flexors and abductors (*platform of strength with software BEP*).	There was significant improvement in functionality (*p*<0.01), hip flexors, extensors and abductors muscles strength (*p*<0.05), and knee extensors for the IG . There were no significant differences for the control group.
Stockton and Mengersen, . 2009[6]	Clinical trial n=57	Treatment Group (twice a day conventional physiotherapy and functional exercises) (n=30)	Once a day of conventional physiotherapy (n=27)	Functionality (*Iowa Level of Assistance hip score Oxford*).	There was no difference between groups.
Sashika et al.,1996[9]	Non-Randomized Clinical Trial n=23	Group A (ROM and isometric exercises) (n=8) Group B (ROM, isometric and eccentric exercises) (n=8)	CG(n=7)	Knee extensors and hip flexors strength (*MMT*), maximum isometric strength of hip abduction (isokinetic dynamometer) and ROM (*JOA hip score*).	The maximum isometric hip abduction torque increased in the three groups in the hip submitted to THA (Group A: *p*<0.01; Group B: *p*<0.01; and Control: *p*<0.05). However, there was no difference between the groups.

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Continuation of Table 1

Author, year	Design and Subjects	Intervention Group (IG)	Control Group (CG)	Analyzed variables	Results
Giaquinto et al., 2010[16]	Prospective Interventional Cohort Study n=64	HTG (hydrotherapy group) (n=31)	NHTG (no-hydrotherapy group = conventional exercise) (n=33)	Functionality (*WOMAC*).	HTG had better result for functionality (*p*<0.01) than the NHTG group.
Galea et al., 2008[18]	Clinical Trial n=23	Unsupervised exercise (n=12) Supervised exercise (n=11)	-	Functionality (*WOMAC*).	There was no significant difference between the groups.
Tsukagoshi et al., 2014[30]	Randomized controlled trial n=65	WB group (Weight-bearing) (n=22) NWB group (Non-weight-bearing) (n=21)	CG(n=22)	Functionality (*HHS*) and isometric muscular strength of knee extensors, and hip abductors, flexors and extensors (hand dynamometer)	There was significant improvement in functionality (*p*<0.01) for WB group compared to the CG. There were no significant differences between the WB and NWB groups.
Barker et al., 2013[31]	Randomized controlled trial n=80	Treatment group (Tailored Protocol) (n=40)	Traditional Protocol (n=40)	ROM of hip flexion, extension and abduction (Goniometer), muscle strength of hip flexors, extensors and abductors (hand dynamometer), and Functionality (*UCLA, OHS, HOOS, EuroQol*)	There was a significant improvement in functionality (*p*<0.011) for the treatment group than the CG. There was also a significant improvement in flexion, extension (*p*<0.0005) and abduction (*p*<0.004) hip ROM in the IG than the CG.
Rahmann et al., 2009[35]	Randomized controlled trial n=54	Aquatic exercise Physiotherapy Program (Aquatic exercise - (fast pacemetronome 80–88bpm) (n=18) Aquatic exercise Program (Aquatic exercise - slow pacemetronome 50–58bpm) (n=19)	Ward Exercise program (conventional exercise during hospitalization) (n=17)	Hip abductors and knee extensors strength (hand dynamometer), ROM of knee flexion (Goniometer), and functionality (*WOMAC*).	Hip abductor strength was significantly greater after aquatic physiotherapy intervention (fast pacemetronome 80–88bpm) than ward exercise program (*p*=0.001) or water exercise program (slow pacemetronome 50–58bpm) (*p*=0.011)
Unlu et al., 2007[42]	Randomized controlled trial n=26	Home exercise program (Conventional exercise) (n=9) Exercised under physiotherapist supervision in hospital (Conventional exercise) (n=8)	CG (n=9)	Hip abduction strength (isokinetic dynamometer).	Maximal isometric hip abduction torque improved significantly in the supervised (*p*=0.012) and home therapy (*p*=0.018) groups. The supervised group showed the best improvement for abduction torque (*p*=0.006).

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Continuation of Table 1

Author, year	Design and Subjects	Intervention Group (IG)	Control Group (CG)	Analyzed variables	Results
Jogi et al., 2015[33]	Clinical Trial n=30	THA Exercise (Conventional exercise) + Balance (n=13)	THA Exercise alone (Conventional exercise) (n=17)	Functionality (*WOMAC*).	There was a significant improvement in functionality in both groups (*p*<0.01). There was no difference between groups for functionality.
Husby et al., 2009[10]	Randomized controlled trial n=24	Maximum strength + conventional treatment (STG) (n=12)	Conventional rehabilitation group (CRG) (n=12)	1RM leg press; Hip abductors strength (1RM) and functionality (*Merle d'Aubigné and Postel*)	No significant difference was observed for functionality in the STG than the CRG. 1RM Leg press for the healthy leg was significantly improved in the STG (*p*=0.044) than the CRG. From 6 to 12 months, hip abduction in the healthy limb improved in the CRG (*p*=0.031).
Temfemo et al., 2008[22]	Clinical Trial n=81	Standard rehabilitation and isometric exercises with electromyographic feedback (n=40)	CG (Standard rehabilitation alone) (n=41)	Maximum voluntary isometric hip strength (isokinetic dynamometer).	The addition of exercises with electromyographic feedback provides increased strength of the operated *gluteus medius* seven days after surgery (*p*<0.001).
Umpierres et al., 2014[7]	Randomized controlled trial n=106	Exercise and instructions (THAPCP) (n=54)	Only instructions (THAP) (n=52)	Functionality (*Merle d'Aubigné and Postel*), hip flexion, extension, adduction, abduction, and internal and external rotation ROM (Goniometer), muscle strength of knee flexion and extension, and hip flexion, extension, adduction, abduction, and internal and external rotation (*Kendall test*).	The THAPCP group obtained better results for flexion, extension (*p*<0.001), adduction (*p*=0.003), abduction (*p*=0.002), internal rotation and external rotation strength and functionality (*p*<0.001)
Wójcik et al., 2012[21]	Clinical Trial n=35	Experimental group (conventional therapeutic exercises, and fascial relaxation) (n=25)	CG (conventional therapeutic exercises) (n=10)	ROM of hip flexion, extension, abduction, adduction, internal and external rotation (Goniometer).	The IG had a significant increase in abduction (*p*=0.04), adduction (*p*=0.01) and internal rotation (*p*=0.03) hip ROM than the CG.
Liebs et al., 2010[25]	Randomized controlled trial n=203	Ergometer Cycling and conventional treatment (n=99)	CG (conventional treatment) THA (n=104)	Functionality (*WOMAC*).	The IG had a significant improvement in functionality (*p*=0.046) than the CG.
Suetta et al., 2004[20]	Randomized controlled trial n=36	Electrical stimulation (n=11) Resistance training (n=13)	Home Exercise (n=12)	Knee extensor isokinetic strength (isokinetic dynamometer)	The resistance training group obtained better results for knee extensor strength (*p*<0.05).

to be continued

Continuation of Table 1

Author, year	Design and Subjects	Intervention Group (IG)	Control Group (CG)	Analyzed variables	Results
Suetta et al., 2008[38]	Randomized controlled trial n=36	Resistance training (n=13) Electrical stimulation (n=12)	Standard rehabilitationn (n=11)	Knee extensor muscle isokinetic strength (isokinetic dynamometer)	The resistance training group obtained better results for dynamic extensor muscle strength (p<0.05).
Suetta et al., 2004[37]	Clinical Trial n=30	Standard rehabilitation and strength training (n=11) Standard rehabilitation and neuromuscular electrical stimulation (n=10)	Standard rehabilitation (n=9)	Knee extensor muscle maximum isometric strength (isokinetic dynamometer).	The resistance training group obtained better results for knee extensor muscle isometric strength (p<0.01).
Mikkelsen et al., 2014[44]	Randomized controlled trial n=62	Intervention group (home-based exercise and progressive resistance training) (n=32)	CG (home-based exercise) (n=30)	Hip abductor and flexor strength (hand dynamometer) and functionality (*HOOS*).	There was no difference between groups for all outcome measures.
Nankaku et al., 2016[43]	Clinical Trial n=28	Exercise group (Conventional rehabilitation and exercise external rotator) (n = 14)	GC (Conventional rehabilitation) (n = 14)	Hip flexion and abduction ROM (Goniometer), knee extensor and hip external rotator and abductor strength (hand dynamometer).	Hip abductor strength (p<0.05) improved significantly in the IG after the intervention.
Monticone et al., 2014[24]	Randomized controlled trial n=100	Experimental group (task-oriented exercises and abandoning of any support for walking) (n=50)	CG (open chain kinetic exercises, partial weight-bearing and support walking after surgery) (n = 50)	Functionality (*WOMAC*)	There was a significant improvement in functionality (p<0.001) in the IG.
Pohl et al., 2015[32]	Clinical Trial n=58	Sensorimotor training 6 times a week (n=23) Sensorimotor training 4 times a week (n=15) Sensorimotor training twice a week (n=20)	-	Functionality (Lequesne).	There was significant improvement in functionality over the time (p< 0.001), but this did not differ between groups.

to be continued

Continuation of Table 1

Author, year	Design and Subjects	Intervention Group (IG)	Control Group (CG)	Analyzed variables	Results
Smith et al., 2008[29]	Randomized Clinical Trial n=60	Gait re-education and Bed Exercise (n=30)	Only gait re-education (n=30)	Functionality (*ILOA*).	There was no difference between groups for all outcome measures.
Matheis and Stöggl, 2018[50]	Controlled trial n=39	Intervention group (mobilization and strength training) (n=20)	CG (n=19)	Hip flexion, abduction, and extension ROM (Goniometer), functionality *(Merle d'Aubigné, HHS* and *WOMAC*).	The IG showed significant improvement in hip flexion (p<0.01), extension (p<0.001) and abduction (p<0.01) ROM.
Winther et al., 2018[39]	Randomized controlled trial n=60	Conventional physiotherapy (n=29)	Maximal strength training (n=31)	Functionality (*HOOS* and *HHS*) and abductor strength (pulling apparatus)	The IG showed significant improvement in abductor strength ($p \leq 0.002$)
Monaghan et al., 2017[26]	Randomized controlled trial n=63	Exercise and usual care group (n=32)	Control group (usual care only) (n=31)	Functionality (*WOMAC*) and hip abductors strength (dynamometer.	The IG had a significant improvement in functionality (p<0.01).

Abbreviations: THA: Total Hip or Knee Arthroplasty; ROM: Range of motion; HHS: Harris Hip Score; FIM: Functional Independence Measure; WOMAC: Western Ontario and McMaster Universities; MRC: Medical Research Council; MMT: Manual Muscular Testing; ILOA: Iowa Level of Assistance Scale; OHS: Oxford Hip Score; HOOS: Hip Disability and Osteoarthritis Outcome Score; UCLA: UCLA Activity Score, 1RM: One-Maximum Repetition.

Table 2. Jadad scale-based classification of risk of bias for the studies included in the systematic review. Campo Grande, Mato Grosso do Sul, 2019.

Author, year	Randomized	Suitable randomization?	Double blind	Suitable double blind?	Sample losses	Punctuation	Quality
Gremeaux et al., 2008[8]	Yes	Yes	No	-	Yes	3	High Quality
Liebs et al., 2012[13]	Yes	Yes	No	-	Yes	3	High Quality
Hesse et al., 2003[14]	Yes	Yes	No	-	Yes	3	High Quality
Husby et al., 2009[41]	Yes	Yes	No	-	Yes	3	High Quality
Heiberg et al., 2012[10]	Yes	Yes	No	-	Yes	3	High Quality
Jan et al., 2004[17]	Yes	No	No	-	Yes	1	Low Quality
Trudelle Jackson and Smith, 2004[11]	Yes	Yes	No	-	Yes	3	High Quality
Stockton and Mengersen al., 2009[6]	Yes	No	No	-	Yes	1	Low Quality

to be continued

Continuation of Table 2

Author, year	Randomized	Suitable randomization?	Double blind	Suitable double blind?	Sample losses	Punctuation	Quality
Sashika et al.,1996[9]	No	-	No	-	Yes	1	Low Quality
Giaquinto et al., 2010[16]	Yes	No	No	-	Yes	1	Low Quality
Galea et al., 2008[18]	Yes	No	No	-	Yes	1	Low Quality
Tsukagoshi et al., 2014[30]	Yes	Yes	No	-	Yes	3	High Quality
Barker et al., 2013[31]	Yes	Yes	No	-	Yes	3	High Quality
Rahmann et al.,2009[35]	Yes	Yes	No	-	Yes	3	High Quality
Unlu et al., 2007[42]	Yes	Yes	No	-	Yes	3	High Quality
Jogi et al., 2015[33]	Yes	No	No	-	Yes	1	Low Quality
Husby et al., 2010[10]	Yes	Yes	No	-	Yes	3	High Quality
Temfemo et al., 2008[22]	No	-	No	-	No	0	Low Quality
Umpierres et al., 2014[7]	Yes	Yes	Yes	Yes	No	4	High Quality
Wójcik et al., 2012[21]	No	-	No	-	No	0	Low Quality
Liebs et al., 2010[25]	Yes	Yes	No	-	Yes	3	High Quality
Suetta et al., 2004[20]	Yes	Yes	Yes	Yes	Yes	5	High Quality
Suetta et al., 2008[38]	Yes	Yes	No	-	Yes	3	High Quality
Suetta et al., 2004[37]	Yes	No	No	-	Yes	1	Low Quality
Mikkelsen et al., 2014[44]	Yes	Yes	No	-	Yes	3	High Quality
Nankaku et al., 2016[43]	Yes	No	No	-	Yes	1	Low Quality
Monticone et al., 2014[24]	Yes	Yes	No	-	Yes	3	High Quality
Pohl et al., 2015[32]	Yes	No	No	-	Yes	1	Low Quality
Smith et al., 2008[29]	Yes	Yes	No	-	Yes	3	High Quality
Matheis and Stöggl, 2018[50]	Yes	No	No	-	Yes	1	Low Quality
Winther et al., 2018[39]	Yes	yes	No	-	Yes	3	High Quality
Monaghan et al., 2017[26]	Yes	yes	No	-	Yes	3	High Quality

Evaluated Outcomes

Regarding the outcomes, 23 articles evaluated functionality, 21 studies evaluated muscular strength, and eight analyzed range of motion.

DISCUSSION

The present study proposed to describe the effects of physiotherapy on functionality, muscle strength, and range of motion in patients submitted to THA, following OA. In general, high intensity resistance exercises (dynamic and isometric) are more effective in improving functionality. Concerning muscle strength and range of motion, dynamic exercises with 3 to 5 sets of 8 to 12 repetitions, with low and high intensity, promoted more substantial gains than other therapeutic modalities.

Functionality

There is evidence that patients submitted to THA can present persistent functional deficits, associated with biomechanical limitations and changes in gait kinematics, derived from the surgical procedure and/or pain[23].

The results of three studies have shown that daily movement-based functional exercises can restore functionality in patients submitted to THA[10,18,24-26]. However, it should be reported that the functional exercises used by the cited authors were generally accompanied by cycling and walking[10,24,25].

Regarding resistance exercises, it is stated in scientific literature that this intervention modality is effective for functional gain in healthy older adults[27,28]. In this context, previous studies revealed that low[27] and moderate intensity[28] resistance exercise improved functional performance in this population. In our findings, a low-scoring study on the JADAD scale showed that low intensity resistance exercise protocols promoted positive functionality results in patients submitted to THA[18]. However, two high quality studies, according to the JADAD scale, showed that low intensity resistance exercises did not modify functionality[8,15]. In addition, a study considered to be of high quality showed that exercises without external resistance are not effective in achieving significant gains in functionality[29]. Therefore, the potential of resistance exercise protocols is not fully established, considering the effects of different exercise loads on the functionality of patients with THA. For this reason, further studies are needed to elucidate the influence of resistance exercise on the functional recovery of THA.

Moreover, studies have documented that dynamic and isometric exercises, used as part of the physiotherapeutic treatment of THA, resulted in significant functional benefits[7,8,11,14,17,29-33]. When these exercises are accompanied by balance exercises, the functional outcomes are even more positive for these patients[32,33]. Therefore, resistance exercise can improve functionality as it enhances muscle strength, which is required to execute most activities of daily living, as strength is a predictor of functional capacity[34].

The studies cited in the present review present inconclusive results about the efficacy of aquatic physiotherapy on the functionality of patients with THA. According to the studies by Husby et al.[15] and Rahmann et al.[35], which were considered to be high quality, compared the effects of water- and land-based exercises and observed that both therapies promoted increased functionality; however, they found no significant differences between the two therapeutic modalities. In the studies by Stockton et al.[6] and Giaquinto et al.[16], which were classified as low quality by the JADAD scale, hydrotherapy presented better results than land-based exercises for functionality. Furthermore, according to Liebs et al.[25], hydrotherapy is effective for functionality, but only if performed after suture removal. Therefore, the positive scientific evidence for hydrotherapy is weak, due to the methodological quality of the identified studies. More studies should be performed to better clarify the role of hydrotherapy as a therapeutic method in THA.

Muscle strength

Classically, the chronic condition of osteoarthritis contributes to a decline in muscle strength. In addition, surgical procedures further increase this reduction[36]. Therefore, muscle strengthening should be part of rehabilitation goals after THA. The studies included in this review contributed to the prescription of muscle strengthening protocols after THA.

In relation to dynamic exercises, the prescription of a protocol with two sets of 10 repetitions is recommended to increase muscle strength in untrained individuals[37]. Among our findings, only eight studies showed the number of series and repetitions used in dynamic exercise protocols[7,9,17,20,29,37-39].

For the quadriceps muscle, the prescription of 3 to 5 sets of 8 to 10 repetitions was found to enhance muscle strength for subjects undergoing total hip arthroplasty[20,37,38]. In the study by Umpierres et al.[7], three sets with 12 repetitions improved the muscle strength of the extensors, abductors, adductors and rotators of the hips, and the knee flexors and extensors. Tsukagoshi et al.[30] observed that three sets of 15 repetitions resulted in increased knee extensor strength, as well as hip abductor, extensor and flexor strength. According to Sashika et al.[9] and Jan et al.[17], two sets of ten repetitions each increased hip abduction, flexion and extension muscle strength. These data show that protocols with 2 to 3 sets of 8 to 12 repetitions appear to be safe not only for healthy individuals, but also for patients with total hip arthroplasty.

It is also important to discuss the safe load to achieve significant gains in muscle strength. Load prescriptions of 60% to 70% of 1-repetition maximum (1RM) are indicated to increase muscle strength in healthy older adults[40]. This review shows significant results for strength improvement in patients submitted to THA with moderate to high intensity prescriptions, using 50%, 65%, 70%, 80%, 85, 90% 1RM[15,20,37-39,41]. However, muscle strength was also increased when low intensity exercises (10%, 30% and 40% 1RM) were used[13, 29,49,50].

Load prescription, whether low or high intensity, is very important. Five studies included in this review compared groups of patients submitted to THA who performed load exercises with groups without load. In these studies, the groups submitted to resistance exercises showed better muscle strength performance than the groups without load[20,30,37,38,44].

Regarding the effectiveness of the isometric exercises, the results on the strength gains of subjects submitted to THA are unclear. In six studies, isometric exercise was used as the treatment protocol[11,22,30,31,35,42]. In three of these, the authors observed increased strength for the hip abductors, flexors and extensors, and for the knee extensors[22,30,42]. However, one of these studies received a low score on the JADAD scale[22]. Three studies considered to be of high quality did not detect an improvement in strength in the group that performed isometry against gravitational resistance only[11,31,43].

Most of the included studies did not report the prescribed exercise in detail, making comparisons and conclusions on the type of prescription required to achieve a strength gain with isometric exercise difficult. There is evidence that isometric exercises produce strength gains when 6 repetitions held for 30 to 40 seconds are performed in healthy older adults[45]. In this review, quadriceps strength gain was achieved with prescriptions of three repetitions sustained for 20 seconds in patients undergoing THA[30]. Although isometric exercise is effective for achieving strength gain, more studies are needed to clarify the type of prescription appropriate for subjects with THA.

In turn, strength improvement due to hydrotherapy intervention is reported in literature, especially when associated with equipment that increases resistance. In addition, this modality that can be prescribed safely, in order to potentiate muscular conditioning and reduce the risk of exercise-associated injuries[46]. In this sense, three studies observed the effects of hydrotherapy on muscle strength in patients submitted to THA[15,35,41]. In general, hydrotherapy seems to present better strength improvement results than isometric exercises[44]. However, when compared to high-intensity exercises, hydrotherapy does not present significant strength improvement results, even if combined with exercises performed on land[15,41]. Regardless, hydrotherapy can be used in the early stages, when patients are unable to perform ground-based exercises, or are unable to fully or partially support their body mass[47].

Another treatment technique reported in the studies was biphasic electrotherapy with a frequency of 40 Hz[20,37,38] or 10 Hz[8]. The results showed that the use of electrotherapy alone does not increase the strength[8,20,37,38]. However, electrotherapy seems to increase the potential effects of resistance exercise on quadricep muscle strength[8]. These results are similar to those found by Hauger et al.[48], in which neuromuscular electrostimulation combined with exercise further enhanced quadriceps strength in patients with another condition. Therefore, electrotherapy can be effective as a coadjutant to physiotherapeutic treatment, when combined with resistance exercise.

Regard the influence of the presence of the physiotherapist during exercise, one study concluded that patients who performed exercises with supervision exhibited more significant and positive results for the improvement of hip abduction strength, when compared to groups without supervision[42]. Considering this issue, Kuru et al.[49] studied the effect of a supervised physiotherapy program on older adults with knee osteoarthritis. The sample was divided into two groups that performed the same protocol for 6-weeks; however, only one group under supervision. According to the results, strength gains were greater for the group that performed exercise with supervision. These results suggest that supervision affects the results of muscle strength gain and functionality, most probably because the professional controls speed of execution, rest intervals, load adjustment, and other important variables to make the performance more efficient and obtain better results.

Range of motion

In relation to hip range of motion, this review found that exercises performed in three sets, from eight to 12 repetitions, for the gluteal and thigh muscles, are effective to increase the range of motion (ROM) of the flexion, extension, abduction, adduction, and internal and external rotation of this joint[8,41]. When a prescription with fewer sets and repetitions (two sets of ten repetitions) was performed, these positive results were not maintained[9].

Isometric exercises, when combined with another exercise modality, were also effective for increasing the ROM of the hip flexion, extension, abduction, and internal and external rotation in patients submitted to THA[21,31]. In relation to the studies included in this review, isometric exercises were combined with unloaded active exercises, gait training[21], stretching, and functional exercises[31]. Furthermore, the association between isometric exercises and myofascial release techniques promoted an even more satisfactory improvement in hip ROM[21].

Most of the studies included in this review used resistance exercise to increase ROM. The study by Fatouros et al.[40] reinforces these results, since these authors observed greater flexibility in older adults who performed resistance training with three sets, using 40% (low intensity), 60% (medium intensity) and 80% (high intensity) 1RM. The authors concluded that resistance training improves flexibility in older adults; however, better results are obtained using 60% 1RM (moderate intensity)[40]. In addition, when passive and active mobilization is added to the resistance exercise protocol, joint ROM seems to increase more rapidly[50]. The data also showed that the positive effect on ROM gain is greater when a physical therapist performs orientation exercise execution[7,10].

CONCLUSION

In conclusion, the physiotherapy techniques and protocols used for THA rehabilitation are varied and have important proven clinical efficacy in literature. The analyzed clinical trials showed significant improvement in the experimental groups compared to the control groups for all the outcomes evaluated (functionality, muscle strength, ROM). In general, protocols with active exercises for the hip periarticular muscles and knee extensors, and which were supervised, provided a better functional prognosis. However, although most of the studies were rated as high quality by the JADAD scale, the results should be analyzed with caution, since several protocols with different combinations of therapies were observed.

Considering the importance of evidence-based practice in clinical decision making, it is suggested that randomized clinical trials are carried out, which specify the training methods (such as the type and speed of muscle contraction, and the frequency and intensity of the exercises), so that suitable, safe therapies may be prescribed for the post-surgical rehabilitation process of total hip arthroplasty.

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