REVIEW ARTICLE

Resistance exercise in osteoarthritis: a review

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ABSTRACT

Osteoarthritis is the most common joint disease in the world, and in Brazil it is estimated to affect 6 to 12% of the adults and one third of the elderly population. There is evidence that exercise, especially resistance exercise, may reduce disease progression. **Objective:** The aim of this study was to review the literature regarding resistance exercise as a treatment for osteoarthritis. **Method:** Articles indexed in the PubMed database were reviewed by employing the "therapy narrow" filter, through the "clinical queries" interface. Twenty studies were selected for full text review. Several types of resistance exercise interventions, with different intensities, duration and speed were studied by other authors. **Results:** The various types of resistance exercise seem to be safe and effective in promoting functional improvements and pain reduction in osteoarthritis patients. Low intensity and isometric exercises can also promote benefits. **Conclusion:** Adherence to the programs is close to 50% and the combined use of supplements or drugs along with exercise has been little studied so far in this population.

Keywords: Osteoarthritis, Exercise, Rehabilitation

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INTRODUCTION

Osteoarthritis (OA) is the most common joint disease in the world.[1] It is estimated that in Brazil it afflicts approximately 6-12% of adults and more than a third of the elderly.[2] Osteoarthritis of the knee is considered as the main cause of disability for people older than 50 years.[3] As a disease that generates high costs for the health system, in the US alone the annual costs from OA are around US$ 47.8 billion.[4,5]

Osteoarthritis is a chronic multifactorial disease that compromises the joint components. This compromising generates joint stiffness, deformities, pain, and functional reduction.[6] Many treatments have been pointed to as forms of intervention for the broad clinical presentation of the disease, among them medications, surgeries, physical therapy, natural remedies, and the practice of physical exercises.[7-12]

With osteoarthritis, exercising seeks to improve the amplitude of movement, muscle strength, and physical well-being, instead of the immobility formerly recommended for this type of disease.[13] Among the various types of exercises, resistance exercises stand out (RE, performed against some form of gradual resistance), and their effectiveness demands attention.[14-16]

Probably due to muscle weakness being one of the main physical signs of OA, interventions with RE have been more recommended in recent years. Individuals with OA show about 15-18% muscle strength loss at the onset of the disease, and that increases with its progression.[17]

Muscle weakness has been associated with functional loss,[18] and it is known that loss of strength in the periarticular region can result in instability and abnormal stress on the joint.[19] Thus, there is evidence suggesting that muscle strengthening may reduce the progression of the disease.[18]

OBJECTIVE

The objective of this study was to review the literature of works on RE as a treatment for OA in order to identify the clinical advantages that this type of intervention can bring to sufferers of this condition.

METHOD

This study reviewed articles indexed in the PubMed database, without restricting the publication date. The descriptors used were the terms "osteoarthritis" AND "resistance training." The search was made in March of 2014. The filter applied was "therapy narrow" of the interface "clinical queries," which yielded 44 publications. The abstracts were analyzed and those whose subjects showed arthroplasty in the joint studied, that discussed only experimental protocols, studies that did not involve RE, and those whose sample involved patients with functional disabilities from diverse etiologies were excluded. Only randomized studies were included in this review. The authors analyzed the selected articles, following the chronological order of publications, and the occasional disagreements were resolved in consensus.

RESULTS

Twenty-four of the 44 studies analyzed by abstracts were excluded. They discussed: patients who went under arthroplasty (10 studies), research protocols (5 studies), other types of exercise (6 studies), and various functional disabilities (3 studies). Thus, 20 articles were selected for review and after a careful analysis of their content, 4 categories were identified: RE seeking to improve pain and/or function (n = 12); adhesion to a program (n = 4); comparison between aerobic exercises (AE) and RE (n = 4), and RE associated with a supplement or medications (n = 2). Three studies were classified into 2 categories simultaneously.

The 20 studies included in this review provided data from 2614 individuals with OA who participated in the proposed interventions, divided into experimental group (n = 1645) and control group (n = 969).

Resistance exercises to improve pain and/or function

The studies seeking to improve pain and/or function obtained their samples using clinical and radiological diagnostic criteria, dividing them into one or more experimental groups (EG) and into one control group (CG). However, 2 studies[19,20] opted to analyze a program with minimum load and no progression as the control condition *versus* a EG whose program was based on load progression; and another study,[21] comparing two types of RE, did not include a CG.

Most samples were composed of subjects of each gender[21,22,24-30] with age above 50 years.[23-26,28-31] Eight studies had small samples, with less than 30 subjects per group.[19-22,27,29-31]

The studies analyzed the impact of exercises on the functional capacity, especially with the tests going up and down stairs,[22,23,29,30] getting up from a chair,[21,22,29,30,31] the WOMAC physical function subscale,[26,29,30,31] and walking.[19-22,24-31] Pain was evaluated in most studies with the WOMAC pain subscale.[19,20,23,24,25,27,29,30]

The proposed interventions varied in method, intensity, duration, and type of therapy, as shown in Chart 1. The time to analyze the intervention effect was diversified, with the analyses of the immediate pre- and post-intervention periods,[19-31] follow-up after 6 weeks,[29] 2 months,[24,25] 6 months, and 12 months after the therapy.[25]

Some studies associated the RE with the AE,[24,25,27] while others examined forms of RE;[19-23,26,28,30] one study compared conventional RE with electrostimulation,[29] and three studies examined RE interventions by using elastic bands.[21,23,31] Studies that involved interventions with different performance intensities or speeds[21,28,30] observed greater benefit related to the more intense/quicker intervention. The influence of weight reduction on the variables studied was also analyzed,[27] and the intervention showed better results with the combination of exercises and diet.

Resistance exercises seeking adherence to a program

All the studies composed their samples dividing them into CG and EG,[24,25,32] with one of them creating two EGs.[33] The samples were composed by males and females, mostly aged above 60 years,[24,25,33] and all of them had more than 50 subjects per group.

The studies analyzed the impact of interventions on the adherence to exercise through session attendance[24,25,32,33] and duration of exercise in each session.[33] The level of physical activity was evaluated through an accelerometer,[32] and self-efficacy was analyzed through the application of efficacy scales.[24,25]

The interventions of the four studies analyzed involved participation in three weekly sessions, however, they varied as to the type of therapy, intensity, and duration, as shown in Chart 2. All the studies analyzed the pre- and post-intervention periods, but one of them monitored it for more than 15 months,[33] and two other studies monitored their subjects for six months after the intervention.[24,25]

One study compared RE with AE,[33] two studies evaluated an RE and an AE program,[24,25] and another evaluated the impact of an RE program and education on adherence and the level of physical activity of OA patients.

All the interventions resulted in greater adherence of the EG, close to 50%.[24,33]

Chart 1. List of the articles on RE intervention to improve pain and/or function

Study	EG	CG	Frequency Intensity	Duration Sessions	Conclusion
Foroughi et al. 2011a[19] (K)	• High intensity RE (knee extension and flexion, hip adduction and abduction, leg press and plantar flexion)*	• RE with minimum load, without progression, neither hip adduction nor abduction*	3 times/week 80% of peak power 3 series/8 repetitions	26 weeks w/supervision Duration of session NI	Reduction of pain in both groups, strength increased without change in the load distribution in knee and hips
Foroughi et al. 2011b[20] (K)	• Progressive RE (knee extension and flexion, hip adduction and abduction, leg press and plantar flexion)*	• RE with minimum load, without progression, neither hip adduction*	3 times/week 80% of peak power 3 series/8 repetitions	26 weeks w/supervision Duration of session NI	Greater strength improvement in the EG, pain reduction in both groups. No change in the alignment of joints
Fukumoto et al. 2014[21] (H)	• RE with elastic bands at high speed* • RE with elastic bands at low speed*	There was none	7 times/week Intensity regulated by the elastic band resistance 3 series/10 repetitions	8 weeks At home Duration of session NI	More dramatic functional improvement in the high-speed RE group. Similar pain reduction in both groups. Greater adipose and fibrous tissue reduction in the high-speed RE group.
Gür et al. 2002[22] (K)	• Concentric RE* • Concentric and excentric RE*	W/O intervention	3 times/week Intensity NI	8 weeks w/supervision Duration of session NI	Functional improvement, pain reduction, torque increase, and in the muscular cross-sectional area in the EG.
Topp et al. 2002[23] (K)	• Isometric RE≈ • Dynamic RE≈	W/O intervention	3 times/week Intensity regulated by the elastic band's resistance 3 series of 3-5 seconds/12 repetitions (isometric) 3 series/12 repetitions (dynamic)	16 weeks 1 supervised session/week 2 sessions at home/week 50 minutes (isometric) 40 minutes (dynamic)	Functional improvement and pain reduction in both EG
Hughes et al. 2004[24] (KH)	• RE# • AE# • education#	• orientation booklet • list of community programs	3 times/week RE intensity NI	8 weeks w/supervision 90 minutes	Functional improvement, reduction of pain and of joint stiffness
Hughes et al. 2006[25] (KH)	• RE# • AE# • flexibility exercises# • education#	• orientation booklet • list of community programs	3 times/week RE intensity NI	8 weeks w/supervision 90 minutes	Reduction of pain and of joint stiffness
Lin et al. 2007[26] (K)	• Computerized proprioceptive facilitation exercises* • Closed kinetic chain exercises*	• education	3 times/week Load up to 25% of body weight 10 series/10 repetitions	8 weeks w/supervision Duration of session NI	Functional and proprioceptive improvement, increase of strength for both GE
Ghroubi et al. 2008[27] (K)	• RE and AE* • diet, RE and AE* • diet	No intervention	3 times/week 60% of peak power	8 weeks RE w/supervision 30 minutes RE	Functional improvement, pain reduction, increase of strength and of cardiovascular aptitude and weigh reduction in the 3 EG
Jan et al. 2008[28] (K)	• High-intensity RE* and education • Low-intensity RE group* and education	No intervention	3 times/week High-intensity RE: 60% of peak power 3 series/8 repetitions Low-speed RE: 10% of peak power 10 series/15 repetitions	8 weeks w/supervision 30 minutes (high intensity) 50 minutes (low intensity)	Functional improvement and pain reduction in the two EG, with slightly greater effects in the high-intensity group
Bruce-Brand et al., 2012[29] (K)	• RE* • Electrical stimulation*	No intervention	3 times/week Intensity NI 3 series/10 repetitions	6 weeks RE: 2 sessions w/supervision/week 1 session at home/week 30 minutes	Functional improvements in pain, physical and mental health, and in the muscular cross-sectional area in both groups
Sayers et al. 2012[30] (K)	• Explosive power RE* • Slow-speed RE*	• Flexibility and warm-up exercises*	3 times/week Explosive power: 40% of peak power 3 series/12-14 repetitions Slow speed: 80% of peak power 3 series/8-10 repetitions	12 weeks w/supervision 15-20 minutes	Improvement of function, pain reduction, and muscle strength increase in both EG, power and speed increase in the explosive power group
Chang et al. 2012[31] (K)	• RE with elastic band* and standard treatment	• Standard treatment	2-3 times/week Intensity regulated by the elastic band's resistance 3 series/10 repetitions	8 weeks w/supervision Duration of session NI	Improvement in function, balance, and pain in the EG

K: osteoarthritis of the knee (s); KH: osteoarthritis of the knee (s) or hip (s); H: osteoarthritis of the hip (s). # sessions in group; * individual sessions; ≈ some sessions in group and some individual. EG: experimental group (s); CG: control group; RE: resistance exercise; AE: aerobic exercise. NI: not informed

Chart 2. List of articles with RE intervention seeking adherence to a program

Study	EG	CG	Frequency Intensity	Duration Sessions	Conclusion
Hughes et al. 2004[24] (JQ)	• RE, AE, and education#	• orientation booklet • list of community programs	3 times/week RE intensity NI	8 weeks w/supervision 90 minutes	Increase in exercise time in the EG, greater adherence than the CG.
Hughes et al. 2006[25] (JQ)	• RE, AE, flexibility exercises and education#	• orientation booklet • list of community programs	3 times/week RE intensity NI	8 weeks w/supervision 90 minutes	Greater self-efficacy for exercise and increase in weekly time of physical activity in the EG, maintained after 12 months
Farr et al. 2010[32] (J)	• RE# • RE and education#	• education#	3 times/week 50-75% of 3 maximum repetitions 1-2 series/6-8 repetitions	9 months w/supervision 60-minute RE	Great adherence of the EG, increase in the moderate and vigorous daily activities, also verified in the CG in the first 3 months
Rejeski et al. 1997[33] (J)	• RE# • AE#	• education#	3 times/week 2 series/10-12 repetitions RE intensity NI	W/supervision for 3 months at home for 15 months 60 minutes	Similar adherence in the two EG, previous active behavior was the best predictor

K: osteoarthritis in the knee (s); KH: osteoarthritis in the knee (s) or hip (s). # sessions in group. EG: experimental groups; CG: control group; RE: resistance exercise; AE: aerobic exercise

Self-efficacy for exercise tends to increase with the participation in a structured program,[25] in which there is careful planning according to the characteristics of the volunteer so that the sessions are individualized.

Comparison between aerobic and resistance exercises

All the studies in this category refer to the same sample, divided into one CG and two EGs (or "groups" like before?), composed of subjects with clinical and radiological evidence of OA.[33-36] Each group had more than 100 subjects, males and females and older than 60 years.

Together, the four studies analyzed the impact of the interventions on functionality, aerobic aptitude, strength, pain, depression, social support, self-efficacy, general state of health, and cost of the interventions.

The interventions proposed in the two EGs involved three weekly sessions of either RE or AE, as shown in Chart 2. The researchers conducted the programs with close supervision in the first three months, and after that period, the subjects started to exercise at home for another 15 months, with less frequent supervision.

The main findings of these works were the improvement in function and in physical performance for both groups,[34] greater pain reduction in the group submitted to AE,[33] increase of self-efficacy for exercise, mediation of pain and of self-efficacy in the effect of treatments,[35] similar retention in the three groups of the study, functional benefits similar for AE and RE, and lower cost of intervention with RE.[36]

Resistance exercises associated with supplements or medications

The studies shown here had a CG in which the subjects received the intervention with RE and made use of a placebo substance. In the EGs, in addition to participating in the intervention, the individuals made use of either a supplement,[37] anti-inflammatory, or an articular cartilage-protecting medication.[38]

These samples were composed of subjects aged above 50 years,[37,38] either with only females[37] or with both genders,[38] and the groups studied contained from 11 to 13 subjects.

The studies analyzed the efficacy of interventions by evaluating lean mass, strength and function tests, quality of life, pain and stiffness,[37] muscular cross-sectional area, strength and power, functional capacity, and satellite cells count.[38]

In both studies, the subjects received treatment three times a week for 12 weeks. The RE associated with creatine supplements produced improvements in function, quality of life, and an increase of lean mass in the lower limbs.[37] When associated with an anti-inflammatory or cartilage-protecting medication, the RE caused strength improvement and pain reduction.[38]

DISCUSSION

The review of the literature on RE in the treatment of OA revealed that this type of intervention is an efficacious treatment modality, since all the studies analyzed showed improvements in the variables analyzed.

Various modalities of interventions with RE were tested, which varied in intensity and duration. In the shortest duration study[29] (6 weeks), although showing only a tendency to increase isometric and isokinetic strength, it was possible to observe improvements in function, pain, physical and mental health, as well as in the muscular cross-sectional area. This evidence indicates that OA patients seem to respond to RE in the same way as healthy subjects.[39]

The impact of exercise was evaluated especially in relation to the aspects of pain and function. All the studies that analyzed the pain[19-25,27-31] component, observed a reduction after the RE program. Two studies analyzed interventions of high and low intensity,[19,20] and found pain reduction in both cases, although more pronounced in the subjects that practiced more intense exercise. This also suggests the possibility of pain reduction in patients who practiced low intensity exercise.

The pain reduction in patients with OA submitted to resistance exercises has been attributed to increased muscle strength and stability in the afflicted joint,[40] as well as to the joint's consequent load reduction.[41] However, the pain reduction witnessed in the short-duration programs may be attributed to the frequent contact with a health professional and to the reduction in anxiety and depression provided by participation.[42]

One study compared the effects of dynamic and isometric RE on the pain and function of OA patients,[23] and concluded that both interventions were effective in reducing pain and increasing functionality. Other authors

studied either a concentric-eccentric isokinetic intervention or only concentric,[22] and found improvement in pain and functionality in both groups, with a slight advantage to combined intervention on function. The eccentric phase was safer, more efficacious, and better tolerated by the patients. In most daily activities eccentric and concentric actions are demanded consecutively, therefore, RE programs for OA patients must include both.

Studies that compared interventions at both high and low-speeds[30,21] observed improvements in strength, muscle power, and function in both situations. The muscle performance gains of the patients were similar to those observed in healthy individuals.[30] However, the groups that trained at high speed obtained a better advantage[30,21] and a more dramatic improvement in muscle composition.[21] The authors suggest that high-speed exercises be part of programs for OA patients, for they increase their confidence in the daily activities that demand speed.[30]

The studies related to adherence revealed that about half of the OA patients adhered to the RE programs.[24,33] The strongest adherence predictor seemed to be previous experience with physical activity,[33] and participation in the RE seemed not to reduce the level of the patients' other daily physical activities.[32] The long-term benefits to the OA patient stemming from the regular practice of resistance exercise are highly dependent on adherence to the program,[43] therefore this matter should not be neglected when developing interventions for these patients.

Comparisons between RE and AE revealed improvements in function and physical performance in both cases,[34] greater pain reduction in the patients submitted to AE[33] and similar functional benefits.[36]

More than simply choosing the type of exercise, the structure of the program seems to be a key consideration when prescribing exercises to OA patients. In clinical practice, it is perceived that non-structured efforts and the application of overloads that exceed the physical condition of the patient worsen his clinical presentation. One example is the common complaint after intense efforts such as going up and down stairs, long walks, and other activities that demand the strength and resistance of the muscles adjacent to the knee joint. Thus, the gradual increase of loads that considers the pain threshold could interrupt the pain-movement inhibition-muscle weakness cycle.

RE associated with creatine supplements can produce improvements in function, quality of life, and increase the lean mass in the OA patients.[37] However, the use of anti-inflammatory or cartilage-protecting medication associated with RE can bring improvement in strength and pain reduction, without increasing lean mass.[38]

There are reports of sensory-motor function decline in OA patients,[44,45] which may contribute to the progression of the disease. Nevertheless, in the present review, no study directly pointed to this question as an object of evaluation. As RE can be considered an efficacious treatment for OA and its limitations, it is probable that the sensory-motor function be also improved in patients submitted to an RE intervention, however, new studies that seek confirmation of this benefit should be made.

CONCLUSION

The many forms of RE studied in the literature seem to be safe and efficacious in promoting functional improvements and pain reduction in OA patients. The adherence to exercise programs is close to 50% in the long term (more than six months) and the combined and supervised use of supplements or medications was not well studied, althout creatine seemed to have a positive effect in relation to the increase of lean mass and functionality.

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