

Kristensen J, Franklyn-Miller A. Resistance training in musculoskeletal rehabilitation: a systematic review. Br J Sports Med 2012; 46: 719-726.

Critique author: Linda Metzger

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Design: Systematic review of randomized controlled trials and observational studies

Objective: To review the efficacy of resistance training (RT) as a therapeutic modality in various musculoskeletal conditions including tendinopathy, knee osteoarthritis, anterior cruciate ligament reconstruction, and hip replacement surgery.

PICOS:

- **Patient population:** adult patients having clinically diagnosed tendinopathy (299), knee osteoarthritis (433), anterior cruciate ligament reconstruction (189) and hip replacement surgery (75).
- **Intervention:** Resistance training (RT) as part of rehabilitation
- **Comparison:** Other rehabilitation programs
- **Outcomes:** maximal strength, functional ability, pain reduction and quality of life (QoL)
- **Study types:** randomized controlled trials and observational studies

Study selection:

- PUBMED/MEDLINE, CINAHL and Sport Discus databases were searched for English publications up until April 2010
- Search terms were knee osteoarthritis, Achilles/patellar tendinopathy, anterior cruciate ligament (ACL) reconstruction, hip replacement surgery
- No specification of whether risk of bias was assessed in the analysis of articles.
- Inclusion criteria included (1) studies with an intervention period lasting a minimum 4 weeks, (2) studies with more than one clinically relevant outcome measure, (3) studies using patients suffering from a clinically diagnosed musculoskeletal condition and (4) studies using external resistance in addition to bodyweight as part of the RT intervention.

Results:

- Meta-analysis was not conducted and results are presented descriptively.
- The general state of the literature leaves much to be desired, since many of the studies were very old. Only 5 of the included 35 studies were published in 2009 or 2010 with the remaining 30 studies published before 2009.
- Fifteen studies with a total of 291 patients (mean ages 25-49 years) focused on chronic tendinopathy.
 - o Five studies using eccentric-only RT were associated with decreased pain and improved function immediately after exercise intervention for chronic

- Achilles tendinopathy and 2 of these studies continued to show long term improvements compared to concentric-only and eccentric-concentric training.
- Three studies on the benefits of RT for patellar tendinopathy were inconsistent. Two studies reported that 12 weeks of heavy slow eccentric-concentric RT improved abnormal tendon morphology in patellar tendinopathy compared with eccentric-only training.
 - Seven studies with a total of 436 patients (mean ages 48-69 years) focused on knee osteoarthritis (OA).
 - Six studies reported that patients who participate in RT show improvements in pain, muscular strength, and functional ability and may retard disease progression.
 - Three studies observed a trend towards better results with high-intensity RT above 60% of 1 repetition per minute (RM) with regards to improving strength, reducing pain and improving functional ability.
 - One study reported that participation in a progressive high-intensity RT program, using an exercise intensity of about 80% of 1 RM retarded disease progression in knee OA patients by favorably impacting cartilage morphology.
 - Seven studies with a total of 189 patients (mean ages 19-31 years) focused on rehabilitation after anterior cruciate ligament (ACL) reconstruction surgery.
 - Three studies suggests that RT is effective at improving quadriceps muscle strength, functional ability and reducing pain in patients postsurgery, but not more so than other exercise training programs. This indicates that postsurgery, RT offers no additional benefits over other conventional types of exercise in promoting a return of muscle strength and functional ability, at least in the short term.
 - Six studies with a total of 75 patients (mean ages 58-82 years) focused on rehabilitation after hip replacement surgery.
 - All six studies concluded that participation in a high-intensity RT program (>70% of 1 RM) increased maximal muscle strength in patients having undergone hip replacement surgery and this increase was observed as early as 4-5 weeks after the start of a RT program with some of the strength gains and neuromuscular adaptations still evident 11 months after cessation of the RT program.
 - Two studies showed significant improvement in a range of functional performance parameters such as walking speed, stair climbing and seated-to-standing time performing RT after hip replacement surgery.
 - One study compared the effects of RT to percutaneous neuromuscular electrical stimulation (NMES) and conventional rehabilitation and showed that only RT resulted in a significantly reduced length of hospital stay, prevented postsurgery muscle atrophy, and increased muscle cross-sectional area and maximal muscle strength 12 weeks postsurgery. The RT protocol consisted of a progressive increase in training intensity from 65% of 1 RM immediately after hospital discharge up to 80% of 1 RM for the last 6 weeks.
 - Three studies showed that RT resulted in significant increases in muscle rate of force development (RFD).

Authors' conclusions:

- RT is a valid therapeutic tool in the rehabilitation of a variety of musculoskeletal conditions, especially those where loss of muscular strength and functional ability is evident, such as knee osteoarthritis, chronic tendinopathy, and after hip replacement surgery.
- RT can increase muscle strength, reduce pain and improve functional ability in patients suffering from knee osteoarthritis, and chronic tendinopathy and those under recovery after hip replacement surgery.
- High-intensity RT does not appear to be beneficial after post ACL reconstruction surgery.
- These results indicate that the use high-intensity of RT immediately postoperatively in hip replacement patients shortens the time before hospital discharge and that continuing RT postdischarge can show improvements in maximal strength, RFD and functional performance even in an advanced age group.
- High intensity RT protocols (~70% of 1RM) in the rehabilitation of musculoskeletal injuries show that this approach is well tolerated by patients and clearly ameliorates rather than exacerbates symptoms and appears to be more effective than a low-intensity approach.
- High-intensity RT training does not increase the likelihood of injury, provided that patients are gradually introduced to heavier loads through periodised RT.
- RT is effective across all ages and gender.
- More research is needed to further elucidate what constitutes optimal RT protocols in musculoskeletal rehabilitation. New findings indicate that the principles of an effective RT program which have proven effective in a healthy population can also be applied successfully in the rehabilitation of an injured population, despite the many inherent concerns.

Comments:

- The success of RT in increasing muscle strength and functional ability after hip replacement surgery is potentially attributable to the fact that physical stress on the new hip joint is kept to a minimum, while the surrounding muscles are strengthened through contractile activity.
- High-intensity RT is also the most effective form of resistance exercise in a healthy population.

Assessment:

This adequate review provides good evidence that 4 weeks of resistance training is effective for improving maximal strength, functional ability, and reducing pain when used as a therapeutic rehabilitation program for various musculoskeletal conditions including chronic tendinopathy, knee osteoarthritis, and after hip replacement surgery.