

REVIEW ARTICLE (META-ANALYSIS)

Early Aquatic Physical Therapy Improves Function and Does Not Increase Risk of Wound-Related Adverse Events for Adults After Orthopedic Surgery: A Systematic Review and Meta-Analysis

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Abstract

Objectives: To investigate whether early postoperative aquatic physical therapy is a low-risk and effective form of physical therapy to improve functional outcomes after orthopedic surgery.

Data Sources: Databases MEDLINE, CINAHL, AMED, Embase, and PEDro were searched from the earliest date available until October 2011. Additional trials were identified by searching reference lists and citation tracking.

Study Selection: Controlled trials evaluating the effects of aquatic physical therapy on adverse events for adults <3 months after orthopedic surgery. Two reviewers independently applied inclusion and exclusion criteria, and any disagreements were discussed until consensus could be reached. Searching identified 5069 potentially relevant articles, of which 8 controlled trials with 287 participants met inclusion criteria.

Data Extraction: A predefined data extraction form was completed in detail for each included study by 1 reviewer and checked for accuracy by another. Methodologic quality of included trials was assessed independently by 2 reviewers using the PEDro scale.

Data Synthesis: Pooled analyses were performed using random effects model with inverse variance methods to calculate standardized mean differences (SMDs) and 95% confidence intervals (CIs) (continuous outcomes) and risk difference and 95% CIs (dichotomous outcomes). When compared with land-based physical therapy, early aquatic physical therapy does not increase the risk of wound-related adverse events (risk difference = .01, 95% CI = -.05 to .07) and results in improved performance of activities of daily living (SMD = .33, 95% CI = .07–.58, $I^2 = 0\%$). There were no significant differences in edema (SMD = -.27, 95% CI = -.81 to .27, $I^2 = 58\%$) or pain (SMD = -.06, 95% CI = -.50 to .38, $I^2 = 32\%$).

Conclusions: After orthopedic surgery aquatic physical therapy improves function and does not increase the risk of wound-related adverse events and is as effective as land-based therapy in terms of pain, edema, strength, and range of motion in the early postoperative period.

Archives of Physical Medicine and Rehabilitation 2013;94:138-48

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The importance of early mobilization after orthopedic surgery has been well documented,¹⁻³ and there is evidence to suggest that the earlier subjects can commence mobilization and strengthening after orthopedic surgery, the quicker their return to functional activities.² Early mobilization, however, can be limited by pain and reduced muscle coordination, strength, and ability to bear weight in the early postoperative period.⁴ In addition, an intensive land-based physical therapy program may result in high dropout rates in older adults.⁵

Hydrotherapy can be defined as exercise in warm water⁶ and can be used for muscle strengthening, flexibility, cardiovascular

fitness, and improved psychological effects.⁷ The physical properties of water in a hydrotherapy pool make it a medium that provides the support and comfort in which to commence exercising in early rehabilitation postsurgery: buoyancy decreases apparent body weight^{8,9} and lower limb internal joint forces,¹⁰ allowing postoperative subjects to practice walking unaided in water early in their rehabilitation. Drag forces provide resistance to movement,^{7,11} which allows the progression of exercises throughout rehabilitation. When immersed, the body has fluid pressure (which increases with depth) exerted on all surfaces.¹² The resulting hydrostatic pressure gradients produced during immersion cause a shift in fluid from the lower limbs to the cardi thoracic compartment, which can result in a reduction of edema in the legs.^{13,14}

No commercial party having a direct financial interest in the results of the research supporting this article has or will confer a benefit on the authors or on any organization with which the authors are associated.

The aquatic environment can therefore be used to regain mobility, strengthen muscles, commence early weight bearing, and help reduce pain and perceived discomfort,³ allowing the subject to achieve more than he or she usually can on land and may even eliminate the need for any other form of physical therapy.¹⁵ A systematic review comparing the effects of aquatic physical therapy and land-based exercise for people with arthritis found that aquatic exercise was comparable to land-based exercise in terms of functional outcomes and recommended aquatic physical therapy as an alternative to land-based physical therapy when people are unable to exercise comfortably on land.¹⁶

Despite the rationale for early aquatic physical therapy in rehabilitation and anecdotal popularity with subjects,¹⁷ there is conflicting information on how soon wounds can be immersed after orthopedic surgery and when the optimal time to commence aquatic physical therapy is. Some recommend that subjects must wait until 2 weeks postoperation to allow for wounds to heal,^{18,19} others suggest that subjects be allowed to submerge in water 1 week after surgery,¹ and yet others have documented that it is common practice to commence aquatic physical therapy as early as 4 days postoperatively.^{15,20,21}

Precautions and contraindications associated with aquatic physical therapy may explain some of the variability in recommendations found in the literature. For example, open wounds are contraindicated²² (but may be immersed if they are covered with an occlusive waterproof dressing²³) because there may be concerns for delayed wound healing and increased susceptibility of wound infections.²⁴ In addition, the physiological changes that occur during immersion such as increased central blood volume due to hydrostatic pressure gradients⁶ means that certain medical conditions such as cardiovascular disease may contraindicate aquatic therapy or require modification of the program for subject comfort and safety.²²

Aquatic physical therapy, used alone or in combination with land-based physical therapy, is widely used as part of rehabilitation after orthopedic surgery^{2,17}; however, we were unable to locate any reviews that have synthesized data on the risks and effects of early aquatic physical therapy within 3 months after orthopedic surgery. A systematic review completed in 2002 concludes that there exists high- to moderate-quality evidence on the benefits of aquatic physical therapy for adults with rheumatic conditions and chronic low back pain but adds that aquatic physical therapy after orthopedic surgery has “received little attention from researchers to date.”^{17(p519)} Adverse events after aquatic therapy are not well documented, and it is not clear whether there is a risk difference (RD) between aquatic physical therapy and land-based physical therapy. Therefore, the research questions for this review were: is early aquatic physical therapy for adults after orthopedic surgery low risk in terms of wound-related adverse events and beneficial (in regard to reducing

impairment and increasing activity and participation) when compared with land-based physical therapy?

Methods

This review was conducted and reported with reference to PRISMA²⁵ guidelines for high-quality reporting of systematic reviews and meta-analyses and has been registered with PROSPERO (registration no.: CRD42011001587 www.crd.york.ac.uk).

Identification and selection of trials

Relevant articles were identified using a search method with 2 main constructs (“aquatic physical therapy” and “orthopedic surgery”) and using synonyms for these terms ([appendix 1](#)) to search the following databases from the earliest date available until October 2011: MEDLINE, CINAHL, AMED, Embase, and PEDro. A reviewer (E.V.) also manually searched reference lists of included articles and of reviews in the field of aquatic physical therapy and completed citation tracking (via Google Scholar) to ensure that all relevant studies were captured. The search was limited to English-language texts. Two reviewers independently screened titles and abstracts of the studies retrieved and applied the inclusion and exclusion criteria ([table 1](#)). Any that clearly did not fulfill the criteria were excluded. Where it was not clear, the full-text articles were obtained for detailed examination. When the full text was obtained, second-stage screening was performed independently by 2 reviewers and any disagreements were resolved by discussion between the 2 reviewers until consensus was reached. If a consensus could not be reached, a third party was consulted.

Inclusion criteria

The trials needed to be controlled trials published in a peer review journal involving adult participants (≥ 18 y old) in the early postoperative period (≤ 3 mo) after any orthopedic surgery. The trials had to compare aquatic physical therapy with land-based physical therapy. For the purpose of this review, aquatic physical therapy refers to any water-based therapy as described by Bartels et al.²⁶ This may include stretching, strengthening, range of motion (ROM), and aerobic exercises. Studies were excluded if the participants had not had orthopedic surgery, if treatment occurred after the early postoperative period (more than 3mo postoperatively), if they included a healthy (nonmatched) comparison group, if they did not use aquatic physical therapy as a treatment modality, and if data on adverse events could not be obtained. Authors of studies without published data on adverse events were contacted directly to obtain this information and where authors responded, these (unpublished) data were included in the review.

Assessment of characteristics of trials

Quality assessment of trials and risk of bias

Quality of the studies was assessed using the 10-point scale of the Physiotherapy Evidence Database (PEDro, www.pedro.org.au): a validated quality assessment tool for randomized controlled trials.²⁷ The PEDro scale assesses bias in clinical trials by scoring items such as concealed allocation, patient and therapist blinding, and use of intention-to-treat analysis. Two reviewers

List of abbreviations:

ACL	anterior cruciate ligament
ADL	activities of daily living
CI	confidence interval
QOL	quality of life
RD	risk difference
ROM	range of motion
SMD	standardized mean difference
THR	total hip replacement
TKR	total knee replacement

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