

Review Article

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The Importance of Strength Training in Post-Operative Orthopedic Rehabilitation

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ABSTRACT

Strength training plays a pivotal role in the rehabilitation process following orthopedic surgeries, addressing key challenges such as muscle atrophy, joint stiffness, and functional limitations. This article explores the comprehensive role of strength training in post-operative care, highlighting its benefits for restoring physical function, improving joint stability, and preventing complications. The integration of targeted strength training helps mitigate the effects of prolonged immobilization, enhances neuromuscular control, and accelerates recovery time. Orthopedic surgeries, including joint replacements, ligament reconstructions, and fracture fixations, often result in weakened musculature and reduced mobility. Through tailored rehabilitation protocols, strength training aids in muscle mass restoration, functional mobility, and bone density improvement. Additionally, it supports psychological well-being by boosting patient confidence and independence. The role of physical therapists is crucial in guiding strength training interventions, from isometric and dynamic exercises to neuromuscular re-education. Evidence-based practices underscore that strength training, when implemented progressively and systematically, leads to better outcomes, reduced pain, and a higher quality of life post-surgery.

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Introduction

Strength training plays a pivotal role in the rehabilitation process following orthopedic surgeries. These procedures, often involving joint replacements, ligament reconstructions, or fracture fixations, can lead to muscle atrophy, joint stiffness, and functional limitations due to prolonged immobilization and reduced activity. The integration of strength training into post-operative care is essential for restoring physical function, improving muscular endurance, and preventing complications such as joint instability or re-injury.

Post-surgery, patients often face challenges such as weakened musculature, impaired balance, and reduced range of motion. Strength training, tailored to the patient's specific condition and stage of recovery, helps rebuild muscle mass and enhance neuromuscular control, which are critical for regaining independence and performing daily activities. Furthermore, it contributes to improving bone density, promoting better alignment, and reducing recovery time by facilitating the body's healing process.

With the rise of evidence-based practices in physical therapy, strength training has become a cornerstone of post-operative rehabilitation protocols. Its benefits extend beyond physical recovery, fostering psychological well-being and boosting patients' confidence in their ability to resume an active lifestyle. By understanding the importance of strength training in post-operative orthopedic care, healthcare providers can offer more comprehensive rehabilitation programs, ultimately improving patient outcomes and quality of life. To increase maximum

strength, IST should be performed at 80–100% MVC with sustained contraction of 1-5 s, and total contraction time of 30–90 s per session, while adopting multiple joint angles or targeted joint angle. Performing IST in a ballistic manner can maximize the improvement of rate of force development [1].

How Exactly is an Orthopedic Surgery Performed

Orthopedic surgery involves the treatment of musculoskeletal conditions, such as injuries or disorders affecting bones, joints, ligaments, tendons, or muscles. The specific surgical procedure depends on the condition being treated, but here's a general overview of how orthopedic surgeries are typically performed:

Preoperative Preparation

- Detailed imaging tests (X-rays, MRI, CT scans) are conducted to assess the condition.
- The patient undergoes preoperative evaluations to ensure they are fit for surgery.
- The surgical site is marked, and anesthesia is administered (general, regional, or local, depending on the surgery).

Incision

- The surgeon makes an incision over the affected area. The size and location of the incision depend on the type of surgery (e.g., minimally invasive, or open surgery).

Accessing the Problem Area

- For arthroscopic surgeries, small incisions are made, and a camera (arthroscope) and specialized tools are used.
- For more extensive procedures, larger incisions are required to fully expose the affected area.

Surgical Intervention

- Metal plates, screws, rods, or pins are used to stabilize broken bones.
- Damaged joint surfaces are removed and replaced with prosthetic components made of metal, plastic, or ceramic.
- Torn ligaments (e.g., ACL) are repaired using sutures or reconstructed with grafts.
- Torn or damaged tendons are sutured back together or reattached to bone.
- The surgeon reshapes or repositions bones to correct deformities or relieve joint stress (Osteotomy).

Closure

- The surgeon carefully closes the incision with sutures, staples, or adhesive strips to promote healing.
- A sterile dressing is applied to protect the wound.

Postoperative Stabilization

- In some cases, the area may be immobilized using a cast, brace, or external fixation device to support healing.

Recovery and Rehabilitation

- The patient is monitored in a recovery area until the effects of anesthesia wear off.
- A rehabilitation program is prescribed to restore strength, mobility, and function.

Orthopedic surgeries are often highly specialized and require a multidisciplinary approach to ensure optimal outcomes, including collaboration between surgeons, anesthesiologists, and physical therapists.

Reasons for Why Orthopedic Surgeries May be Attempted?

Orthopedic surgery is performed on individuals experiencing musculoskeletal issues that cannot be effectively managed through conservative treatments such as physical therapy, medications, or lifestyle modifications. Here's a breakdown of who might undergo orthopedic surgery:

Individuals with Traumatic Injuries

- Severe or complex fractures that cannot heal properly with immobilization (e.g., comminuted, or displaced fractures).
- Joint dislocations requiring surgical intervention to repair ligaments or cartilage.
- Torn ligaments (e.g., ACL), tendons, or menisci that affect mobility and stability.

Patients with Degenerative Conditions

- Severe joint degeneration causing pain and loss of function, often treated with joint replacements (Osteoarthritis).
- Chronic inflammation leading to joint damage that may necessitate surgical intervention (Rheumatoid Arthritis).
- Conditions like herniated discs, spinal stenosis, or spondylolisthesis requiring surgeries like laminectomy or spinal fusion.

People with Congenital or Developmental Disorders

- **Clubfoot:** Deformities in foot structure corrected with surgical procedures.
- **Hip Dysplasia:** Abnormal hip joint development treated with corrective surgeries.
- **Scoliosis:** Severe spinal curvature requiring spinal fusion or other corrective measures.

Individuals with Chronic Pain or Limited Mobility

- Persistent joint pain or stiffness that significantly affects daily activities and quality of life.
- Inability to perform basic movements like walking, bending, or lifting due to musculoskeletal conditions.

Athletes or Active Individuals

- High-performance athletes may require surgery to repair or reconstruct damaged ligaments, tendons, or joints to restore function and enable a return to their sport.

Elderly Individuals

- Commonly undergo surgeries like hip or knee replacements to address age-related wear and tear, such as osteoarthritis or osteoporosis-related fractures.

Patients with Tumors or Infections

- **Bone Tumors:** Surgical removal of benign or malignant tumors affecting bones or joints.
- **Osteomyelitis:** Bone infections that may require debridement or reconstruction.

Individuals with Repetitive Stress Injuries

- Conditions like carpal tunnel syndrome or chronic tendinitis that do not respond to conservative treatment.

Children with Growth Abnormalities

- Pediatric conditions like bowlegs, knock knees, or limb length discrepancies corrected through orthopedic surgeries.

Orthopedic surgery caters to a wide range of individuals, from pediatric to elderly patients, depending on their specific condition, severity, and overall health status. It aims to alleviate pain, restore function, and improve quality of life.

Post Operative Care

Post-operative care following orthopedic surgery is critical for a successful recovery, minimizing complications, and restoring mobility and function. The care plan varies depending on the type and extent of surgery, but it generally includes the following components:

Immediate Post-Operative Care

- Continuous monitoring of blood pressure, heart rate, oxygen levels, and temperature in the recovery area.
- Administration of prescribed medications, such as analgesics, anti-inflammatories, or nerve blocks.
- Ensuring the surgical site is clean and protected with a sterile dressing; monitoring for signs of infection (redness, swelling, discharge).
- Introduction to assistive devices like crutches, walkers, or slings to support movement without straining the surgical site.

Physical Therapy and Rehabilitation

- **Early Mobilization:** Gentle movement exercises, as advised by the surgeon, to prevent stiffness and improve circulation.
- **Strengthening Exercises:** Gradual introduction of physical therapy to rebuild strength, flexibility, and range of motion.
- **Gait Training:** Learning proper walking techniques using assistive devices, when necessary.

Medications

- Prescribed painkillers to manage discomfort.
- To prevent infections, especially in the case of implants or

open procedures, antibiotics are given.

- For preventing deep vein thrombosis (DVT), a potential complication in immobile patients, blood thinners are given.

Infection Prevention

- Regular dressing changes and monitoring for signs of infection.
- Keeping the surgical area dry and clean.
- A balanced diet rich in protein, vitamins, and minerals to promote healing and bolster immunity.

Managing Swelling and Inflammation

- Application of ice packs to reduce swelling.
- the operated limb elevated to minimize fluid accumulation.

Preventing Complications

- Use of compression stockings, blood thinners, and exercises to improve circulation and to prevent DVT.
- Consistent physiotherapy and gradual activity to maintain muscle tone to prevent disused atrophy.

Long-Term Care and Maintenance

- Gradual progression of exercises to rebuild muscle strength and stability.
- Learning ergonomic techniques to minimize stress on the repaired area.
- Continued follow-ups to evaluate recovery and address concerns.

Post-operative care is a team effort involving the surgeon, physical therapist, nurses, and the patient. Adherence to the care plan is essential for optimal recovery, reducing the risk of complications, and achieving the best functional outcomes.

Role of a Physical Therapist in Post-Operative Care

Physical therapists (PTs) play a vital role in post-operative care, guiding patients through the rehabilitation process to restore function, mobility, and strength while preventing complications. Their expertise ensures a structured and safe recovery tailored to each patient's unique needs and surgical procedures.

- Pain and Swelling Management
- Prevention of Complications
- Education and Guidance
- Restoring Range of Motion (ROM)
- Strengthening and Conditioning
- Functional Rehabilitation
- Gait Training
- Neuromuscular Re-Education
- Daily Activities
- Scar Tissue and Soft Tissue Mobilization
- Preventing Re-Injury
- Ergonomic Training
- Sports-Specific Rehabilitation
- Impact of Physical Therapy
- Facilitates faster recovery.
- Minimizes post-operative complications.
- Improves overall function and quality of life.
- Supports a safe return to work, sports, or other activities.
- By providing patient-centered, evidence-based care, physical therapists are indispensable in ensuring a successful post-operative recovery.

The Importance of Strength Training in Post-Operative Orthopedic Surgeries

The loss in muscular strength occurs due to both the underlying condition requiring THR and the surgery itself. Such a decrease may impede recovery time or completeness, thus extending regrettable

long-term disability or low satisfaction among patients [2]. Strength training is a cornerstone of rehabilitation following orthopedic surgeries, as it addresses the muscle atrophy, joint instability, and functional impairments that often result from surgical interventions and prolonged immobilization. By systematically restoring muscle strength and function, strength training facilitates recovery, improves quality of life, and helps patients regain independence. Finally, although the greatest strength and functional losses occur immediately after surgery, there is emerging evidence that strength and functional gains can be made after the acute postoperative recovery period with programs focusing on the use of progressive aquatic exercise or eccentric exercise [3].

Muscle Atrophy Prevention and Reversal

A vital part of avoiding muscle atrophy is doing progressive resistance training during the initial stages of mobilization. Meier et al. (2008) found that patients who engaged in early postoperative rehabilitation experienced faster improvements in muscle strength and functional mobility than those with delayed rehabilitation protocols [4]. Isometric exercises involve contracting the muscles without changing the joint angle, such as isometric hip abduction and adduction. They help maintain muscle strength while minimizing joint stress [5]. Gradual, targeted strengthening exercises help rebuild muscle mass and endurance. Resistance exercises, beginning with isometric contractions and progressing to dynamic movements, counteract atrophy and promote muscle hypertrophy.

Enhancing Joint Stability

Surgeries, such as ligament reconstructions or joint replacements, often leave the joint weakened and prone to instability. Strengthening the muscles around the joint (e.g., quadriceps and hamstrings for the knee) improves dynamic stability and reduces the likelihood of re-injury.

Restoring Functional Mobility

Loss of strength post-surgery limits the ability to perform daily activities like walking, climbing stairs, or carrying objects. Functional strength exercises, such as step-ups, squats, or resistance band exercises, mimic everyday movements, enhancing the ability to resume normal activities. Implement exercises and techniques to prevent deep vein thrombosis (DVT), pulmonary complications, and joint stiffness, such as ankle pumps, diaphragmatic breathing, and gentle passive range of motion (ROM) exercises. Instruction in proper walking mechanics with or without assistive devices to restore balance and reduce compensatory movements.

Improving Range of Motion and Flexibility

ROM activities can improve flexibility and joint movement. Stretching, rotating, flexing, and extending the knee are common movements for a joint's ROM exercise. Using ROM exercises at an early stage has been shown to significantly enhance joint mobility and decrease pain levels. ROM serves as a basic unit in physical therapy and rehabilitation programs aimed at improving or maintaining the ROM in joints (6). Stiffness and restricted movement are common after orthopedic surgeries. Incorporating strength exercises with controlled movement patterns helps maintain and improve joint range of motion while strengthening muscles in a functional manner. Use of manual therapy techniques to prevent adhesions and improve tissue mobility around the surgical site.

Reducing Pain and Improving Circulation

Post-surgical pain and poor blood flow can slow healing and impede recovery. Activating muscles through resistance exercises increases blood flow to the surgical site, delivering oxygen and nutrients necessary for healing. Strengthening stabilizing muscles reduces

the stress on the affected area, alleviating pain during movement. Use of modalities like ice therapy, electrical stimulation, or manual lymphatic drainage to control inflammation and pain.

Accelerating Bone Healing and Density

Bone integrity may be compromised in surgeries like fracture fixation or joint replacements. Weight-bearing and resistance exercises stimulate osteogenesis, promoting bone healing and increasing bone density, crucial for long-term recovery.

Enhancing Neuromuscular Control

Surgeries can disrupt the neuromuscular pathways, leading to impaired coordination and proprioception. Exercises like balance drills, functional resistance training, and plyometrics re-educate the neuromuscular system, enhancing coordination and reducing the risk of falls or missteps. Exercises to enhance coordination, proprioception, and motor control.

Supporting Long-Term Recovery

Without proper strength training, patients may develop compensatory movement patterns that lead to chronic pain or dysfunction. A structured strength program ensures balanced muscle development, preventing overuse of certain muscle groups and promoting sustainable recovery. Educate patients about proper positioning, safe mobility, and the use of assistive devices (e.g., crutches, walkers, braces). Training to safely resume activities of daily living (ADLs), such as dressing, bathing, and driving. Guidance on safe lifting, bending, and other movements to protect the repaired area.

Boosting Mental Health and Confidence

Limited mobility and dependence post-surgery can lead to frustration, anxiety, or depression. Achieving progressive strength goals boosts confidence and fosters a sense of accomplishment, positively impacting mental well-being.

Lifestyle Modifications

Advise patients on lifestyle modifications that support recovery, such as maintaining a healthy diet, managing weight, and avoiding activities that may jeopardize the surgical outcome [6].

Implementation of Strength Training in Post-Operative Care

Phase 1: Early Recovery	Phase 2: Intermediate Recovery	Phase 3: Advanced Recovery
<p>Focus: Gentle isometric exercises and low-load resistance to activate muscles without stressing the surgical site.</p> <p>Example: Quad sets, glute bridges, or light band-assisted movements.</p>	<p>Focus: Progressive resistance training to build muscle strength and endurance.</p> <p>Example: Leg presses, modified push-ups, or dumbbell exercises.</p>	<p>Focus: Functional and sport-specific strength training for a return to full activity.</p> <p>Example: Single-leg squats, plyometric drills, or weighted lunges.</p>

Conclusion

Strength training is an indispensable component of post-operative orthopedic rehabilitation. It not only restores physical strength and functionality but also improves overall health, reduces complications, and enhances quality of life. Tailored and supervised strength training programs ensure patients achieve optimal recovery and regain the confidence to resume their daily

activities and physical pursuits. Muscle impairments that exist following a TKA may persist for years, however improving a quadriceps strength may mitigate these impairments and result in improved functional outcomes [6].

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