

Early Functional Mobilization Prevents Immobilization-Induced Deep Venous Thrombosis

Introduction

Modern orthopedic surgery care aims at restoring musculoskeletal function of the patient as soon as possible without inflicting complications related to operation or to post-operative immobilization. Immobilization causes venous thromboembolism (VTE) resulting in deep venous thrombosis (DVT) and pulmonary embolism.^{1 2}

Complications related to musculoskeletal trauma, operations and lower limb immobilization such as VTE and delayed healing represent increasing problems. The NHS, UK, has identified prevention of VTE as the number one prioritized intervention.^{3 4} Each year 25,000 people in the UK die from VTE. This is a larger number than deaths attributable to breast cancer, AIDS and road traffic accidents combined.^{3 4}

In some patient-groups with acute trauma, pharmacological prophylaxis of VTE (LMWH) is contraindicated, due to eg. high bleeding risk. Moreover, LMWH has been shown to have adverse effects on the healing process⁵ and even delays fracture repair in animals.⁶ Thus, there is a need of developing alternative treatment methods. Moreover, in patients with lower-leg immobilization after injuries LMWH has shown low- or non-effectiveness.^{7 8}

Current trends in orthopedic surgery must take account of well-informed patients with high demands on the orthopedic care including minimal risks associated with the surgical procedures, and short rehabilitation times. Early mobilization post-operatively has been a milestone in reducing the risk for DVT as well as to enhance healing.⁹ However, some operative procedures still demand stabilization, i.e. plaster immobilization, to protect the healing tissue. Recently the detrimental effects of immobilization on tissue repair as well as the increased risk of DVT have been reported.⁹⁻¹²

So how do we counteract the effects of immobilisation in order to minimize post-operative complications and to expedite recovery? We hypothesize that one crucial principle is early mobilization with loading and activation of the calf muscles. Early mobilization with muscle activation can be achieved by dynamic orthosis treatment, which can gradually increase the range of motion.

Patients immobilized in plaster cast after Achilles tendon rupture (ATR) are at especially high risk; the VTE incidence being 36-50%, irrespective of operation or conservative treatment.^{7 13 14} Hence, DVT preventive interventions during lower limb immobilization are often recommended.² Pharmacological prophylaxis has after ATR, however, shown not to be effective in reducing the risk of DVT.⁷ Whether early mobilization with dynamization could reduce the risk of DVT after ATR as compared to treatment-as-usual with plaster cast is yet unknown.

Hypotheses

1. Early functional mobilization after ATR compared to treatment-as-usual with plaster cast followed by orthosis treatment results in decreased incidence of DVT.
2. The amount of weightbearing and the number of daily steps will influence the risk of DVT.

Aims

In a prospective multicenter randomized double blind controlled study we will determine the effect of early mobilization with dynamization compared to plaster cast treatment and subsequent orthosis treatment during six post-operative weeks after Achilles tendon surgery with regards to:

1. Incidence of DVT.
2. Risk factors including the amount of weightbearing and number of daily steps on the risk of sustaining a DVT

Primary Inclusion Criteria

1. Acute Achilles tendon rupture accepted for surgery within 7 days.
2. Age 18-75 years.

Exclusion Criteria

1. Inability or refusal to give informed consent for participation in the study
2. Ongoing treatment with anticoagulant therapy
3. Inability to comply with the study instructions
4. Known kidney disorder
5. Heart failure with pitting oedema
6. Thrombophlebitis
7. Recent thromboembolic event (during the preceding 3 months)
8. Recent surgery (during the preceding month)
9. Presence of known malignancy
10. Current bleeding disorder
11. Pregnancy
12. Wound in the area of operation

Study Design

A prospective randomized multi-center study at the Karolinska University Hospital, Solna Huddinge, Södersjukhuset and Danderyds Hospital. We plan to include 150 patients between 2013 and 2016. Consecutive patients will be randomized after acute Achilles tendon rupture surgery to treatment with either early mobilization with dynamization or standard plaster cast treatment for the first two weeks. From the second until the sixth postoperative week the early mobilization group will be treated with increased dynamization while the plaster cast group will be treated with a stable orthosis. The randomization will take place at the time of completion of surgery.

The surgery will be carried out under local, spinal or general anesthesia without a use of tourniquet. The repair will consist of an end-to-end suture with modified Kessler technique. After surgery the control group patients will be immobilized in a standard below-knee plaster cast with the ankle in 30 degrees of equinus position. At the 2 weeks visit the control group will be immobilized in an orthosis until week 6 postoperatively.

The patients in the early mobilization group will be immobilized in an orthosis (VACOped) which will allow mobility from 15 to 30 degrees of plantar flexion up to 2 weeks post-

operatively. Week 2-6 postoperatively the orthosis will be dynamized to allow 25 degrees of mobility from 5 to 30 degrees of plantar flexion.

<u>Week</u>	<u>Degrees° (ROM)</u>	<u>Weight bearing</u>	<u>Crutches</u>
0-2	15°– 30 ° plantar flexion	as tolerated within pain limit	Recommended
2-6	5°– 30 ° plantar flexion	full	Only if in pain

Patients will be instructed to unload without the orthosis for one hour each day to let the ankle breathe. The mobilization of the patients will be recorded with a pedometer and with self rating scales.

The study will be double blinded for the surgeon and for the assessor of DVT.

End-points

Incidence of VTE

Assessment of DVT: At 2 and 6 weeks post-operatively, all patients will be screened for DVT in the operated leg by unilateral compression duplex ultrasound (CDU). Two experienced ultrasonographers, blinded to the treatment regimens, will perform all the CDU using a Philips CX 50 ultrasound machine (Philips Medical Systems, Andover, MA, USA). The standard procedure includes evaluation of all deep proximal and distal veins, including muscle veins, as well as vena saphena magna. The criteria for DVT diagnosis and the diagnostic procedure have been described earlier.^{7 13 14} Proximal DVT will be defined as a thrombosis that involved the popliteal vein or any more proximal veins, with or without involvement of the calf veins. Briefly, the DVT diagnosis will be based on a transversal ultrasound compression test of the blood vessel, and assessment of blood flow in the veins by color Doppler flow.

The compression duplex ultrasound scans that will be performed at two or six weeks will be re-evaluated after completion of the study, by analyzing the CDU film sequences. The second assessment will be performed by another ultrasonographer blinded to the treatment allocation. This post hoc examination will verify the first diagnosis and validate the methodology.

Assessment of pulmonary embolism: Computer tomography will be used for diagnosis in patients with symptoms of pulmonary embolism. Assessors will be masked to the treatment allocation.

Statistical Methods

Sample size calculation is based on recent studies showing a 50% rate of CDU-verified DVT at 2 and 6 weeks after ATR.^{13 15} Based on earlier studies and our own pilot study, we estimated early mobilization and IPC to confer a 50% risk reduction.^{15 16} In each group, 63 patients will be required to detect a difference of 25% in the incidence of DVT (two-sided type-I error rate = 5%; power = 80%). A 10% drop-out is accounted for, but our experience is less than that. On recommendations from the ethical committee, a ratio of 2:1 was chosen, since our hypothesis was that the early functional mobilization group would perform better.

Separate protocols

This is the protocol for assessment of the primary outcome of this study, i.e. DVT. Separate protocols are available for other outcome measures.

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