

1. A Comparison of Crushed Ice and Continuous Flow Cold Therapy

Barber FA, Am J Knee Surg 13(2):97-101, 2000.

Continuous-flow cold is superior to crushed ice for outpatient ACL reconstruction pain and should not be considered an equivalent modality.

In a study comparing two groups, each a prospective series of consecutive patients of Plano Orthopedic and Sports Medicine Center, Group 1 was assigned the use of continuous-flow cold therapy and Group 2 was assigned crushed ice secured to the knee with an elastic wrap in the immediate post-operative period, continuing for the first 7 days.

"Crushed ice was compared to continuous-flow cold therapy for control of postoperative pain after arthroscopic...anterior cruciate ligament (ACL) reconstruction. Compared to crushed ice, continuous-flow cold therapy lowered VAS and Likert pain scores more, reduced hydrocodone bitartrate with acetaminophen use, was used more often, increased continuous passive motion, increased 1-week knee flexion, and was given significantly higher performance ratings by patients. Continuous-flow cold is superior to crushed ice for outpatient ACL reconstruction pain and should not be considered an equivalent modality."

2. Continuous-Flow Cold Therapy for Outpatient Anterior Cruciate Ligament Reconstruction

Barber FA, et al., Arthroscopy 14(2):130-5, 1998.

Continuous-flow cold therapy is safe and effective for outpatient ACL reconstruction reducing pain medication requirements.

A prospective, randomized series of consecutive patients undergoing outpatient anterior cruciate ligament (ACL) reconstruction were assigned to a cold therapy group or a no-cold-therapy group.

"This prospective, randomized study evaluated continuous-flow cold therapy for postoperative pain in outpatient arthroscopic anterior cruciate ligament (ACL) reconstructions. Continuous-flow cold therapy lowered VAS and Likert scores, reduced Vicodin use, increased prone hangs, CPM, and knee flexion." "Continuous-flow cold therapy is safe and effective for outpatient ACL reconstruction reducing pain medication requirements."

3. Intermittent Pneumatic Compression Enhances Neurovascular Ingrowth and Tissue Proliferation during Connective Tissue Healing: A Study in the Rat

Dahl J, et al., J Orthop Res 25:1185-1192, 2007.

Increased occurrences of [substances released during healing] subsequent to IPC treatment act as regulators of angiogenesis and probably have a role...leading to accelerated tissue healing and improved tissue quality.

This laboratory study investigated the effects of daily 1-hour treatments with intermittent pneumatic compression (IPC) at 2 and 4 weeks post-Achilles tendon rupture in rats. Histological evaluation of the affected tissues in the control group (no IPC) and the test group (IPC) was performed at the end of the study period.

The results showed "...enhanced neurovascular ingrowth following 2 or 4 weeks of IPC treatment after tendon injury." The authors hypothesize that "...the increased occurrences of [substances released during healing] subsequent to IPC treatment act as regulators of angiogenesis and probably have a role...leading to accelerated tissue healing and improved tissue quality."

4. The Role of Cold Compression Dressings in the Postoperative Treatment of Total Knee Arthroplasty

Levy AS, Marmar E. Clin Orthop Relat Res (297):174-8, 1993.

The use of cold and compression results in a dramatic decrease in blood loss and improvements in early return of motion and narcotic use.

A prospective randomized study was performed to evaluate the role of cold compressive dressings in the postoperative treatment of 100 consecutive knees in 90 patients treated with total knee arthroplasty (TKA). Eighty unilateral and 10 bilateral patients participated in this study.

"Cold compression provides significant benefits to the patient undergoing TKA. These include a dramatic decrease in blood loss, diminished swelling, lessened pain, and improved early range of motion."

5. Rehabilitation of the Rotator Cuff: An Evaluation-Based Approach

Millett PJ, et al., J Am Acad Orthop Surg 2006; 14:599-609.

The use of cryotherapy for days 1-6 for pain and inflammation and days 7-28 as needed for pain control and inflammation are recommended per this evidence-based medicine review.

In a review of 43 articles reporting various Level I or Level II prospective randomized studies, anatomic or biomechanical studies, case-controlled studies and expert opinion, an assessment of the management and rehabilitation of rotator cuff disease was devised.

"Rotator cuff disease of the shoulder, a common condition, is often incapacitating. Whether nonsurgical or surgical, successful management of rotator cuff disease is dependent on appropriate rehabilitation. Numerous rehabilitation protocols for the management of rotator cuff disease are based primarily on anecdotal clinical observation. The available literature on shoulder rehabilitation, in conjunction with clinical observation that takes into consideration the underlying tissue quality and structural integrity of the rotator cuff, can be compiled into a set of rehabilitation guidelines. The four phases of rehabilitation begin with maintaining and protecting the repair in the immediate postoperative period, followed by progression from early passive range of motion through return to preoperative levels of function."

6. Continuous-Flow Cold Therapy After Total Knee Arthroplasty

Morsi E, J Arthroplasty 17(6):718-22, 2002.

Continuous cryo group had better outcomes in all endpoints measured.

This was a single-center, prospective comparative study on the effects of continuous cryotherapy on total knee arthroplasty, where published reports are limited and controversial. In this study 30 patients with staged bilateral TKAs were enrolled in two study groups. Group 1 comprised 30 patients with the first TKA procedure using continuous cooling therapy following the procedure. Group 2 comprised the same 30 patients scheduled for their second TKA procedure (performed 6 weeks following the first one) using no cooling therapy.

"The study compared the range of motion, the volume of hemovac output and blood loss, visual analog pain score, analgesic consumption, and wound healing in the 2 limbs of the same patient. This study showed that continuous-flow cold therapy is advantageous after TKA because it provides better results in all the areas compared."

7. Combination of Cold and Compression After Knee Surgery: A Prospective Randomized Study

Schroder D, Passler HH. Knee Surg Sports Traumatol Arthrosc 2(3):158-65, 1994.

The cold/compression group reported significantly less swelling and pain than the cold-alone group.

In a prospective and randomized study at Sportklinik, Stuttgart, Germany, the effect of continuous long-term application of a combined cooling and compression system was investigated. The study compared postoperative therapy using a combined cooling and compression system to ice bag therapy only. Postoperative swelling, ROM, subjective pain, consumption of analgesics, and return of function after anterior cruciate ligament (ACL) reconstruction were documented and patients were observed for any adverse effects, such as deep vein thrombosis.

The "effect of continuous long-term application of a combined cooling and compression system" was compared to traditional ice therapy following anterior cruciate ligament (ACL) reconstruction. Study endpoints included "postoperative swelling, range of motion (ROM), pain, consumption of analgesics, and return of function." In the cold and compression patient group, less pain and swelling was observed compared to the control group. "The evidence from our study shows that continuous combined cold-compression therapy has a number of advantages over cold therapy alone following ACL reconstruction."

8. The Efficacy of Cryotherapy in the Postoperative Shoulder

Speer KP, et al., J Shoulder Elbow Surg 5(1):62-8, 1996.

This study reports less pain and swelling, greater patient comfort, and enhanced rehabilitation with cryotherapy for postoperative shoulder surgery.

This prospective, randomized study included 50 consecutive patients who underwent shoulder surgery and then were admitted to the hospital for at least one night after the procedure. All the procedures were performed by the same surgeon.

This outcomes study "used visual analog scales to evaluate the efficacy of cryotherapy in the postoperative shoulder." In the cryotherapy group, patients reported less severe pain, less frequent pain, better sleep and less perceived need for pain meds. "By postoperative day 10, patients in the cryotherapy group reported their shoulders hurt less often and with less severity. Swelling was less, and shoulder movement hurt less during rehabilitation, enhancing the rehabilitative effort. Cryotherapy offers a number of benefits for care of patients in the immediate postoperative period."

1. A Comparison of Intramuscular Temperature of the Thigh During Treatments with the Grimm CRYOPress and the Game Ready Injury Treatment System

Seamon CL, Merrick MA. J Athletic Training 40(2): S99, 2005.

The smaller and portable Game Ready® System may be used instead of the larger CRYOPress™ for effective cold-compression therapy.

The purpose of this study was to describe and compare the intramuscular temperature change of the anterior thigh for each device. Design and Settings: A 2X2 factorial design with repeated measures on both independent variables (treatment & measurement depth) was used.

In this study, skin and intramuscular temperature were measured at 30-second intervals during baseline and treatment periods. "The principal conclusion is that the smaller, portable Game Ready® device can be used instead of a larger, less portable CRYOPress™ without compromising the thermal effectiveness of the treatment."

2. Active Cooling and Intermittent Pneumatic Compression Device vs. Standard Cold Therapy after Knee Arthroscopy

Goradia VK, Warnock N. (2007): Presented at Arthroscopy Association of North America, April 2007.

Following knee arthroscopy, an active cooling and compression device showed improved range of motion at 2 and 4 weeks postoperatively compared to standard cold therapy.

A single-center, prospective randomized clinical trial was conducted at a sports medicine clinic. Forty patients were randomized to receive either Game Ready® or Dura-Kold® after undergoing knee arthroscopy with partial meniscectomy and/or chondroplasty. Patients with grade IV chondromalacia or those receiving other treatment were excluded. Clinical measurements included knee girth, active flexion, and active extension. Pain was measured using a self-reported Visual Analogue Scale.

"Following knee arthroscopy, an active cooling and compression device showed improved range of motion at 2 and 4 weeks postoperatively compared to standard cold therapy. Reduction in swelling and pain were comparable between treatment groups."

3. The Effects of Continuous Cooling and Cyclical Compression on Intramuscular and Surface Temperatures of the Distal Quadriceps

Womochel KS, et al., Southwest Athletic Trainers' Association Annual Meeting. Arlington, TX, July 2007. First Prize Student Competition.

A study of the effects of continuous circulating water and cyclical compression on muscle and skin temperature in the distal quadriceps after a 30-minute treatment and 30-minute re-warming in 16 healthy volunteers showed "Game Ready® with [cyclic] compression seem[ed] to have a greater magnitude and longer duration of cooling than Polar Care®."

The purpose of this study was to investigate the effects of continuous circulating water and compression on muscle and skin temperature in the distal quadriceps after a 30-minute treatment and 30-minute re-warming. At the Exercise Science Research Laboratories at the University of Texas at Arlington a thermocouple inserted 1.5 cm below subcutaneous adipose tissue in healthy subjects. During treatments, intramuscular temperature was sampled and a skin thermocouple sampled surface temperature. Visual analog scales (VAS) were used to record patients' perceived sensations (0=no cold & 10=very cold) at 5-minute intervals.

"Game Ready® with [cyclic] compression seem[ed] to have a greater magnitude and longer duration of cooling than Polar Care®."