
Subject:	Pneumatic Compression Devices for Prevention of Deep Vein Thrombosis of the Extremities	Publish Date:	09/25/2019
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Description

This document addresses the use of pneumatic compression devices (PCDs) for the prevention of deep vein thrombosis (DVT) of the extremities. This therapy involves the use of an inflatable garment and an electrical pneumatic pump. The garment is intermittently inflated and deflated with cycle times and pressures that vary between devices. Pneumatic compression devices are used in clinics or can be purchased or rented for home use for prevention and treatment of a number of conditions. This document only addresses the home use of pneumatic compression devices post outpatient orthopedic procedures.

Note: This document addresses devices for the prevention of DVT only. Pneumatic devices used in the treatment or prevention of lymphedema, venous insufficiency, and therapy for musculoskeletal injuries are NOT addressed in this document nor are devices for prevention of DVT post major surgical procedures. This document also does not address pneumatic compression devices with combined cooling or heating functions. For more information regarding such devices, please see the following related documents:

- CG-DME-06 Pneumatic Compression Devices for Lymphedema
- DME.00037 Cooling Devices and Combined Cooling/Heating Devices

Clinical Indications

Not Medically Necessary:

The use of pneumatic compression devices for prevention of thromboembolism of the extremities following outpatient orthopedic surgery is considered **not medically necessary** for all indications.

Coding

The following codes for treatments and procedures applicable to this guideline are included below for informational purposes. Inclusion or exclusion of a procedure, diagnosis or device code(s) does not constitute or imply member coverage or provider reimbursement policy. Please refer to the member's contract benefits in effect at the time of service to determine coverage or non-coverage of these services as it applies to an individual member.

HCPCS

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Note: the following PCDs are considered not medically necessary for the situation described in the Clinical Indications section:

- A4600 Sleeve for intermittent limb compression device, replacement only, each
- E0676 Intermittent limb compression device (includes all accessories), not otherwise specified

Note: the following PCD codes, if billed for DVT prophylaxis, are considered not medically necessary for the situation described in the Clinical Indications section:

- E0650 Pneumatic compressor, non-segmental home model
- E0651 Pneumatic compressor, segmental home model without calibrated gradient pressure
- E0652 Pneumatic compressor, segmental home model with calibrated gradient pressure
- E0655 Non-segmental pneumatic appliance for use with pneumatic compressor, half arm
- E0660 Non-segmental pneumatic appliance for use with pneumatic compressor, full leg
- E0665 Non-segmental pneumatic appliance for use with pneumatic compressor, full arm
- E0666 Non-segmental pneumatic appliance for use with pneumatic compressor, half leg
- E0667 Segmental pneumatic appliance for use with pneumatic compressor, full leg
- E0668 Segmental pneumatic appliance for use with pneumatic compressor, full arm
- E0669 Segmental pneumatic appliance for use with pneumatic compressor, half leg
- E0670 Segmental pneumatic appliance for use with pneumatic compressor, integrated, 2 full legs and trunk
- E0671 Segmental gradient pressure pneumatic appliance, full leg
- E0672 Segmental gradient pressure pneumatic appliance, full arm
- E0673 Segmental gradient pressure pneumatic appliance, half leg

ICD-10 Diagnosis

All orthopedic-related diagnoses

Discussion/General Information

The formation of blood clots in veins and arteries, also known as thrombosis, may be caused by injury to a blood vessel, abnormal blood flow or blood that clots more readily than normal as a result of a medical or genetic condition. The most common site of formation for a blood clot (thrombus, plural thrombi) is in the legs, but they may also form in the veins of the arms, the right side of the heart, at the tip of a catheter placed in a vein, or other locations. Blood clots that start in a vein (venous thrombi) pose a significant threat to an individual’s health when they detach from their place of origin. This condition is referred to as venous thromboembolism (VTE). Thromboemboli can migrate through the blood vessels and block the flow of blood to vital organs such as the lungs, brain, and heart.

The large, deep veins of the thigh and calf are a major area of thrombus formation and thrombi that originate there are referred to as deep venous thrombosis (DVT); however, DVTs may occur in any of the deep veins of the body. DVTs most frequently form in individuals with limited mobility, those with abnormal blood flow in their legs, or those with abnormal blood clotting physiology. Other risk factors include childbirth within the last 6 months, the use of medications such as estrogen and birth control pills, a history of certain hematologic diseases, or the

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presence of a malignant tumor. There are numerous other risks, including genetic, environmental, lifestyle and chronic disease factors.

Prevention and treatment of DVT is achieved mainly through the use of drugs that affect clot formation or clot dissolution (e.g., aspirin, heparin, warfarin, etc.). Mechanical devices also play an important role in the prevention of blood clots. Pneumatic compression devices are approved under the U.S. Food and Drug Administration's (FDA's) 510(k) process for the prevention of DVT. They are classified as Class II devices, cardiovascular therapeutic devices, and compressible limb sleeves. Pneumatic compression devices are used to simulate muscle action in the extremities to encourage blood circulation with the goal of preventing formation of a thrombus. These devices involve the use of a sleeve or wrap that contains one or more inflatable air chambers. Attached to the garment is a control unit that controls the flow of compressed air into the air chamber. During use, the air chambers inflate in a distal to proximal fashion and squeeze the body to encourage blood to flow back to the heart. Some devices come with programmable control units. The control units allow variation in the duration and frequency of the inflation cycles as well as the degree of compression in individual air chambers in the garment.

While there is a well-established body of published evidence on the use of pneumatic compression devices to prevent DVT following major surgical procedures in the hospital-setting, their efficacy following ambulatory surgery has not been well studied. There is a paucity of evidence on their efficacy post-operatively for prevention of DVT in the home-setting. Findings from an observational study conducted by Martin-Ferrero (2014) suggests that this may, in part, be due to the low risk of DVT in the post-operative ambulatory setting. In the study, 10,032 individuals who underwent outpatient orthopedic surgical procedures between June 1993 and June 2012 were enrolled and evaluated both pre- and post-operatively (48 hours, 7 days, and 28 days post-op) using a quality-of-life assessment (SF-36) and other quality indicators for orthopedic procedures. Participants' preoperative risk was evaluated according to the American Society of Anesthesiologists' (ASA) criteria (ASA, 2014). Individuals were considered eligible for enrollment if their ASA status was either a I or II or a well-controlled status of III or IV. The major complication rate was minimal and none of the individuals enrolled in the study reported complications of a DVT at 28 days post-procedure. This study was not designed to detect DVT, therefore asymptomatic DVTs would have remained undetected in this population and DVTs have reportedly occurred months following procedures. Therefore, the occurrence of a DVT in study enrollees post study-end cannot be ruled out. Nonetheless, in this very large, observational cohort of individuals following outpatient orthopedic surgery, none developed symptomatic DVT by 28 days post-procedure. There is also evidence from a systematic review and clinical trials evaluating pharmaceutical prophylaxis of DVT after outpatient orthopedic procedures showing that even in the control populations (no intervention), the incidence of DVT was so low that pharmaceutical prophylactic intervention was deemed unwarranted (Huang, 2018; Kaye, 2013; Mathews, 2018).

In 2013, Mauck and colleagues published results of a population-based, retrospective cohort study whose aim was to estimate the incidence of symptomatic VTE after arthroscopic knee surgery. A total of 4833 individuals were followed for up to 3 months post-procedure. Within 6 weeks, a total of 18 individuals (0.4%) developed VTE; no VTE was reported between 6 weeks to 3 months after knee arthroscopy. Of the 18 VTEs, 2 were in individuals taking oral contraceptives at the time of arthroscopy, 1 was pregnant (third-trimester), 2 had known or suspected joint infections, and 3 had recently suffered a trauma. The type of VTEs that occurred were: 1 pulmonary embolism (PE); 1 PE and DVT; and 16 DVTs alone. At the time the VTEs were diagnosed, 3 of the 18 individuals were hospitalized (4, 8, and 38 days post-knee arthroscopy), 6 had been hospitalized in the 3 months prior to the VTE but

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were out-patients at the time the VTE was diagnosed, and the remaining 9 had no hospitalization in the preceding 3 months prior to VTE. Overall, the incidence of symptomatic VTE after knee arthroscopy at 6 weeks post-op in this large, population-based sample was 0.4%. While data on the proportion of study enrollees that had outpatient procedures versus inpatient procedures is not reported, arthroscopic knee surgery is most often performed in the outpatient setting. Authors concluded, “We believe our findings support the ACCP [American College of Chest Physicians] recommendations for no routine pharmacologic or mechanical VTE prophylaxis in this patient population.”

A large, retrospective study was published with the primary aim of characterizing the incidence of symptomatic VTE after arthroscopic knee surgery (Maletis, 2012). In total, 20,770 eligible participants who had no documented history of a VTE and underwent elective knee arthroscopy, without prophylaxis for VTE, were enrolled in the study. Data was extracted from medical chart review up to 90-days post-op for evaluation of VTE occurrence. Overall, the incidence of symptomatic VTE after knee arthroscopy was 0.25% for DVT and 0.17% for PE.

A prospective study published by Mohtadi and colleagues in 2016 sought to determine the rate of DVT after outpatient arthroscopic hip surgery in low-risk individuals who did not receive prophylactic intervention for DVT. Of 120 consented participants, 115 were available for analysis at 10-22 days post-op and again at 3 months. Overall, 5 DVTs were detected (4 symptomatic and 1 asymptomatic) resulting in an incidence of 4.3% (the majority were distal). While arthroscopic hip surgery is widely accepted as a higher risk procedure than arthroscopic knee surgery, authors similarly conclude, “This study provides supportive evidence that routine prophylaxis and/or screening may not be necessary in low risk patients undergoing elective hip arthroscopy.” A very similar trial evaluated the rate of VTE post arthroscopic hip surgery in low-risk individuals without prophylactic intervention (Alaia, 2014). Out of 139 enrolled participants only 2 events were reported (1 symptomatic DVT and 1 PE) for an overall VTE incidence of 1.4%. No cases of asymptomatic VTE were detected via bilateral venous duplex ultrasound at 2 weeks (study-end). This study’s follow-up was relatively short, so incidence of VTE after the 2-week endpoint cannot be ruled out. Data regarding outpatient versus inpatient surgery was not reported. The existing body of literature shows that the incidence of VTE postoperative outpatient orthopedic procedures is low, even following arthroscopic hip surgery which is generally considered higher risk for a thrombotic event amongst outpatient surgical procedures.

In 2008, a Cochrane Review evaluated interventions for prevention of VTE in adults undergoing knee arthroscopy (Ramos, 2008). The background of the systematic review stated,

Surgeons generally agree that thromboprophylaxis should be used in moderate and high risk patients who undergo surgery. Graduated elastic stockings and intermittent pneumatic compression are mechanical devices used to prevent DVT, the latter often used in patients immobilized in bed. There are different opinions about whether or not prophylaxis should be used in knee arthroscopy, partly reflecting different perceptions of the underlying risk of DVT.

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Selection criteria included randomized clinical trials (RCTs) and controlled clinical trials. Interventions included mechanical or pharmacological approaches, alone or in combination, used to prevent DVT in adults undergoing knee arthroscopy. In total, only four trials involving 527 predominantly male participants were included in the final analysis. The review concluded the following:

Although this review suggests that some benefit may be obtained from prophylaxis, we considered only two studies to be of adequate methodological quality with small sample size, and poorly defined or stratified in their arthroscopic intervention. No studies on mechanical devices alone were found, other than the ongoing combined protocol. No strong evidence was found to conclude thromboprophylaxis is effective in preventing thromboembolic events in people undergoing knee arthroscopy with unknown risk factors for DVT.

A 2016 Cochrane Review assessed studies on combined intermittent pneumatic leg compression and pharmacological prophylaxis for the prevention of VTE (Kakkos et al, 2016). The results of the review demonstrated agreement with current guideline recommendations, which support the use of combined modalities in hospitalized individuals (limited to those with trauma or undergoing surgery) at risk of developing VTE. Neither the Cochrane Review nor the published guidelines it references address uses of pneumatic compression devices in the outpatient setting or following ambulatory surgical procedures.

An ACCP Evidence-Based Clinical Practice Guidelines entitled *Prevention of VTE in Orthopedic Surgery Patients: Antithrombotic Therapy and Prevention of Thrombosis* (2012), gives the following recommendations for use of pneumatic compression devices after major orthopedic surgery:

In summary, use of an IPCD [intermittent pneumatic compression device] for thromboprophylaxis is attractive because of its possible effectiveness and likelihood of no increase in bleeding events. However, suboptimal compliance with the use of an IPCD while in the hospital and the inability to continue this treatment at home for most patients may limit their use. Newer battery-powered IPCDs that monitor compliance might be successfully used after discharge.

The ACCP's recommendations regarding knee arthroscopy state the following: "For patients undergoing knee arthroscopy without a history of VTE, we suggest no thromboprophylaxis" (neither pharmaceutical nor mechanical). The ACCP proposes this as a Grade 2B 'Weak' recommendation with 'moderate-quality' evidence. The guidelines offer the following recommendations for future clinical trial research:

Large, practical, RCTs are needed to further study thromboprophylaxis after orthopedic surgeries. Those trials should avoid screening for asymptomatic VTE and ensure that symptomatic VTE is recorded up to 3 months after surgery, regardless of duration of intervention...At a minimum, trials that use mechanical devices for thromboprophylaxis should be able to accurately record and report proper use and daily and cumulative wear time to document compliance.

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In a systematic review published in 2012 Craigie and colleagues evaluated compliance with the use of compression devices. MEDLINE was searched from January 1, 2000 through May 21, 2015 for English-language observational studies that assessed adherence to mechanical prevention of VTE following surgical procedures. Amongst inpatient hospital stays, the study concluded that up to one-fourth of individuals were non-adherent. While no studies were identified that followed individuals post-discharge, it is unlikely adherence levels would be improved in the outpatient setting as the ACCP guidelines suggest.

In a large retrospective analysis of Medicare claims, 2,509,530 lower extremity and 130,258 upper extremity arthroplasty procedures performed in the hospital setting were analyzed for occurrence of VTE. VTE complications occurred in 30,227 (1.2%) lower extremity arthroplasties and 695 (0.53%) upper extremity arthroplasties. Individuals with a primary diagnosis of fracture, history of VTE and comorbidities, were significantly more likely to report occurrence of VTE. This data demonstrates that even amongst aged, hospital-admitted (2-5 day average stay) individuals with significant risk-factors for VTE, the incidence of VTE in upper and lower extremities is rare (Day, 2015). To date, there is no published evidence demonstrating the efficacy of pneumatic compression devices in reducing the incidence of VTE following ambulatory surgery of the upper extremities.

In summary, the majority of published literature to date has not established that there is a significant risk of postoperative DVT following ambulatory orthopedic procedures. Studies have not conclusively shown that home use of pneumatic compression devices reduces the incidence of thromboembolism in any clinical setting. Therefore, mechanical prevention using pneumatic compression devices is not warranted in this setting for individuals of any risk status.

Definitions

American Society of Anesthesiology (ASA) Physical Status Classifications:

ASA I A normal healthy patient

ASA II A patient with mild systemic disease

ASA III A patient with severe systemic disease

ASA IV A patient with severe systemic disease that is a constant threat to life

ASA V A moribund patient who is not expected to survive without the operation

ASA VI A declared brain-dead patient whose organs are being removed for donor purposes

Deep vein thrombosis (DVT): A condition where blood clots in the veins located deep in the extremities. The term "DVT" is usually understood to refer to blood clots in the legs unless otherwise specified.

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Embolus: Any free mass; either solid, liquid, or gas; carried in the blood circulation, which is capable of clogging arterial capillary beds at a site distant from its point of origin.

Pulmonary embolism (PE): A condition where an embolus lodges in the lungs, preventing blood flow to the pulmonary circulation.

Thrombus: Another name for a blood clot.

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Government Agency, Medical Society, and Other Authoritative Publications:

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Websites for Additional Information

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History

Status	Date	Action
Revised	08/22/2019	Medical Policy & Technology Assessment Committee (MPTAC) review. Updated Title, expanded Scope and revised MN statement to include upper extremities. Updated Discussion/General Information and Reference sections.
New	09/13/2018	Updated Coding section; added HCPCS E0655, E0665, E0668, E0672. MPTAC review. Initial document development.

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