Pneumatic Gradient Sequential Pneumatic Compression Therapy
for lymphatic and venous disorders

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Intermittent Pneumatic Compression is generally safe and well-tolerated and appears to provide synergistic benefit when used with decongestive lymphatic therapy (DLT) in the acute decompressive approach to post-mastectomy lymphedema.

Stanford Center for Lymphatic and Venous Disorders
2001

This pamphlet addresses questions we are often asked by physicians, nurses, therapists, and other healthcare professionals regarding pneumatic compression therapies.

ReMarx Medical Services, Inc. provides pneumatic compression therapies to patients for use in the home. Our modalities have been clinically tested and proven, and are convenient as well as safe to use in the home.

As specialists in pneumatic compression therapies, we have evaluated the available systems from all the leading manufacturers. This enables us to recommend and provide the best modality for each patient’s condition. Also our healthcare professionals provide quality patient care and follow-up for your patient.

We are able to attain a high degree patient compliance with all of our modalities and greatly impact the improvement of the patient’s condition.
1. Describe the lymphatic system.

The lymphatic system is a one-way-valved drainage system from the interstitial space to the subclavian vein that transports 2-4 liters of lymph daily. Once the interstitial fluid enters the lymph capillary (consisting of overlapping one-cell-thick endothelial cells), the fluid is then referred to as lymph. The lymph capillaries drain into lymphangions (larger bicuspid valved conduits with smooth muscle within its walls), which empty into a larger vessel called the lymphatic trunk, which finally empties into the lymphatic duct. Periodically throughout the lymphatic system, the lymph fluid is filtered and concentrated by the lymph nodes, which removes any foreign substances or initiates an immune reaction when indicated.

The thoracic duct is the largest lymph vessel in the body, while the cisterna chyli is the most expandable. Three-fourths of the body's lymph fluid drains into the juncture of the left internal jugular vein and subclavian vein via the thoracic duct. The other one-fourth drains from the body's right quadrant into the juncture of the right subclavian vein and internal jugular vein via the right lymphatic duct.

2. What is lymphedema?

Lymphedema is a high-protein edema (protein concentrations of 1 gm/dl or more in the interstitium), as compared to a low-protein edema caused by renal failure or congestive heart failure.

3. What causes lymphedema?

Whenever the lymphatic system is damaged or blocked, a build-up of protein occurs between the tissue cells in the interstitium, which attracts fluid due to a change in the colloid osmotic pressure. Up to one-third of women who require surgery for breast cancer will develop lymphedema in the arm following surgery. Without appropriate intervention, the condition only progresses to limb enlargement, with interstitial fibrinoid material causing a firm nonpitting, brawny (muscle-like) edema. Worldwide, infections caused by parasites (e.g., filarial worms) are the leading cause of lymphedema.
4. How many types of lymphedema are there?

There are two types: primary and secondary.

**Primary lymphedema** (from too few lymphatics): appears at birth (congenital), during puberty (praecox), or after age 35 (tarda).

**Secondary lymphedema**: due to damage or blockage of the lymphatics, caused by:
- Surgery—lymph node resection
- Radiation therapy—damages lymph nodes and vessels
- Fibrotic tissue—constricts vessels
- Traumatic accidents—lymphatic vessels are torn
- Chronic venous insufficiency—overloads lymphatics
- Paralysis—lymph stasis due to ineffective muscle pump

5. How is lymphedema graded?

**Grade 1**: pitting edema which is partially reversible with elevation.

**Grade 2**: nonpitting (brawny) edema which is not reduced by elevation. The skin hardens due to excess fibrotic tissue from a chronic excess of protein in the interstitium.

**Grade 3**: elephantiasis—an enormous swelling of the involved extremity

6. How can you identify the etiology for lymphedema?

The physician can usually distinguish lymphedema from other edemas caused by medical conditions such as congestive heart failure, renal failure, venous insufficiency, or embolus with a good medical history, observations, and, if necessary, special radiologic studies MRI, CT scan, and lymphoscintigraphy. Lymphangiography should *never* be used because the oily contrast medium can cause additional blockage of the lymphatics.

7. How do you measure lymphedema?

There are several methods: volume, circumference, tonometry, and bioelectrical impedance. **Circumferential** measurements (with three marked sites to guide the tape measure around the extremity) is the most frequently used method in the clinic for measuring lymphedema. The uninvolved extremity is always measured as the control. The upper extremity is measured proximal every 5 cm beginning with the ulnar styloid to the axilla. The lower extremity is measured proximal every 10 cm beginning with the lateral malleolus to the groin. A *delta value* can be obtained by subtracting each corresponding measurement (involved - uninvolved = nl)
and adding up all the differences (delta = n1 + n2 + n3 + ....). These measurements can be taken daily, weekly, monthly, and yearly, and by tracking the delta value, the therapist or physician can monitor the patient's progress or regression.

8. How is lymphedema treated?
For the past 15 years the mainstay of lymphedema treatment in the United States has been elevation of the extremity, diuretics, pneumatic pumps (external pneumatic compression devices), compression garments, massage, and surgery.

9. How do pneumatic pumps work?
Pneumatic pumps come in several different designs, and you should read the instruction manual before applying one to a patient. There are compression pumps with either a single compartment sleeve, which inflates in a uniform or non-sequential manner, or a multi-compartment sleeve, which inflates in a sequential or distal to proximal manner. A review of the medical literature indicates that use of sequential and multi-pressure or graded pumps obtain better limb reduction. Recent research indicates that pneumatic pumps are very effective in the reabsorption of water from the interstitial fluid into the venous capillaries, causing a reduction in the size of the lymphedematous limb. However, the large protein molecules still remain in the interstitial fluid, which can cause a Grade 1 (pitting) lymphedema to develop eventually into a Grade 2 (nonpitting) lymphedema. When the sole treatment modality for lymphedema is a pneumatic pump, the patient is required to use it daily (2-6 hours depending upon the severity) for the rest of that patient's life. The patient will also be required to wear a compression garment daily to prevent the limb from refilling with fluid.

10. What is lymph massage?
Manual lymph drainage is a specialized massage technique that stimulates the lymphatic system to remove the large protein molecules from the interstitial fluid via the lymph capillaries. In it, the massage is applied from proximal to distal with circular movements, in which pressure is applied during 50% of the cycle in the direction of lymphatic flow followed by no pressure. This technique emphasizes manual pressure around 30-40mmHg. Manual lymph drainage is contraindicated when an infection is present.
11. When are compression garments worn?

Once the size of the lymphedematous extremity has plateaued, a compression garment is issued to maintain the reduction. Different manufacturers of compression garments have different grades of pressure. Usually, the patient is issued a graded compression garment within the 30-40 mmHg range. Two pairs should be issued, one to wear while the other one is being cleaned. If the patient has good daily compliance in wearing the compression garment, the garments should be worn out and replaced in 4-6 months.

12. What is complex physical therapy (CPT)?

CPT is a combination of advanced techniques used by physical therapists to reduce lymphedema. It consists of five components:

1. Skin care—Daily cleansing, moisturizing the skin with a low-pH lotion, and monitoring for rashes and infections.
3. Compression bandages—The involved extremity is wrapped with a low elastic bandage (versus a high elastic bandage like an Ace wrap) to provide support and compression.
4. Exercises—Stimulate the lymphatics by using muscle contractions as a pump.
5. Compression garment—The size of the involved extremity should plateau by 4 weeks. To maintain this reduction, the patient needs to wear the compression garment during part or all of the day.

In some instances (i.e., mild secondary lymphedema) when CPT has been initiated early enough, there is a possibility that collateral remodeling within the edematous limb will occur to create new lymphatic vessels, and further CPT will not be needed.

13. What are the precautions and contraindications for a compression pump used on a lymphedematous extremity?

Precautions

1. It is best used after manual lymph drainage has been done to clear the lymphatics for the production and transportation of more lymph fluid.
2. Do not exceed pressure settings, frequency, and therapy times that were prescribed by attending physician.
3. Discontinue pumping with an increasing limb circumference above the pump's sleeve.

**Contraindications**
1. Non-Compensated Congestive heart failure
2. Acute deep vein thrombosis of a recent nature
3. Following pelvic surgery when bilateral proximal swelling is present in the legs—it can create genital and/or truncal edema.
4. Pulmonary edema
5. Acute Infection
6. Peripheral arteriosclerosis

**14. Are any drugs effective in treating lymphedema?**

**Diuretics** are *not effective* for high-protein edema. They tend to remove only the water and concentrate the protein in the interstitium. The protein osmotically attracts fluid, and once the diuretic is stopped, the fluid returns and the limb swells again.

**Benzopyrone** increases the number of macrophages with the capacity for phagocytosis and proteolysis. The resulting smaller molecules can easily diffuse through the capillary wall and be removed by the blood flow. 5,6-Benzo-a-pyrones have not yet been approved by the FDA. Though clinical trials are in progress. However, flavonoids (benzo-y-pyrene) are available and can be beneficial in treating lymphedema. One of the side effects can be gastric irritation. Significant reductions in an edematous extremity can be achieved when the use of benzopyrone is combined with the use of a compression pump and CPT.

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What is Venous Insufficiency?
Chronic venous insufficiency (CVI) results from failure of the valves in deep or superficial veins. Venous anatomy in the legs is uniquely designed to allow blood to flow against the force of gravity. One-way valves in the veins close at the end of each pulsatile burst of blood upward toward the heart, ensuring unidirectional blood flow. A damaged valve with bi-directional blood flow can allow blood to flow back from the deep venous system into the superficial venous system.

Over time, the weight of this column of blood causes fluid and protein to exude into surrounding tissues where it leaks and pools in the legs and feet. Chronic venous insufficiency can cause discoloration of the skin of the ankles and may lead to tissue breakdown, and ulceration. Venous ulcers are most commonly found around the ankle. They have irregular borders and are more likely to have copious drainage than other ulcer types.

Chronic Venous Insufficiency (CVI) is a common condition. The symptoms most frequently experienced with CVI are pain and heaviness. The pain is described as an aching throughout the leg. The condition is usually caused by a remote, deep thrombophlebitis that damages the valves in the veins. This results in venous hypertension, ultimately causing edema and other complications. The signs of chronic venous disease may be grouped into three stages. These classifications/stages dictate the degree and intensity of care. Each stage is characterized by:

STAGE 1 - Edema and pigmentation
STAGE 2 - Edema, skinpigmentation, and dermatitis
STAGE 3 - Varicosities, edema, skin pimentation, dermatitis, and ulceration

Treatment
Venous Insufficiency is often accompanied by edema and decreased oxygen and nutrient composites in tissue. Since lymph drainage can be augmented by external pressure, proximal venous flow also benefits from external compression, the use of pneumatic compression devices to treat venous insufficiency has proven highly successful. Pumping promotes cutaneous circulation which increases the oxygen content of tissues.

STAGE 1:
Gradient elastic stockings
Skin care
STAGE 2:
  Gradient elastic stockings
  Skin care
  Topical steroids for dermatitis
  Surgical consultation

STAGE 3:
  Gradient elastic stockings
  Ulcer care (a) Antiseptic solution (b) Bio-occlusive dressings
  Pneumatic, gradient compression pump therapy

What is Venous Stasis Ulcer?
Venous stasis, the cessation or impairment of venous flow, and the accompanying ulceration is a commonly occurring problem. Management of this condition presents a large problem to community nursing services and consumes considerable health resources. Venous stasis ulceration occurs as an end result of sustained high pressure in the veins of lower extremities. Damage to either the deep or superficial veins then results. As the venous pressure rises and venous stasis occurs, capillaries are stretched and become more permeable. The protein leaks out of the vascular bed into the surrounding tissues. Fibrinogen is converted to fibrin and coats the capillaries, interfering with the exchange of oxygen and nutrients. Tissue breakdown begins and venous ulceration occurs. Venous stasis leg ulcers are characteristically persistent and slow to heal - making a multifaceted treatment protocol necessary. Traditionally, many approaches have focused only on dressing systems which are directed to the wound healing process itself, as opposed to the underlying cause.

Treatment
Comprehensive care for patients with venous ulcers must include local wound care and adequate compression therapy. Wound care protocol should include the following:
- Debridement
- Skin care
- Infection control
- Revascularization
- Compression therapy

Ulcers should be cleaned with either peroxide, Dakin's solution or potassium permanganate once per day. Bio-occlusive dressings can be applied and changed every 2-7 days. These dressings promote formation of good granulation tissue and rapid healing.
Compression therapy protocol should include the following:
- Medical Compression Stockings
- Pneumatic Compression Pump Therapy

In many cases, particularly in older patients, the effective level of compression required is greater than that which the patient can tolerate. Thus, an alternative approach is to include a pneumatic compression pump in the protocol. The compression pump reduces venous stasis by promoting venous blood flow and has been shown to enhance fibrinolytic activity. Compression therapy must continue after the ulcer is healed, often for the duration of the patient's lifetime.

Insurance Reimbursement
Documentation Checklist for Medicare Claims

| Patient's Name: ________________________________ |
| HICN#: ________________________________ |

1. Lymphedema caused by
   - radical surgical procedure with removal of lymph nodes (997.99)
   - post radiation fibrosis (692.82 or 457.0)
   - spread of malignant tumors to regional lymph nodes with lymphatic obstructions (457.0)
   - scarring of lymphatic channels (need to answer questions 5 thru 8)-venous ulcers(457.1,454.0 and 459.81)
   - onset of puberty (757.0)
   - congenital abnormality (757.0)

2. Elevation tried: when? ____________
   Sample Results: a.) girth/size measurements increased or stayed the same, and/or b.) Unable to control edema

3. Custom fabricated gradient pressure garments tried: yes or no, if yes when ________
   Sample Results: a.) same as #2 above b.) could not tolerate or apply due to sensitive skin area in the _____ area of the leg or arm. c.) could not tolerate due to ulcer/scar in the _____ area of the leg or arm. d.) pt. could not don/doff as a result of _______. (Ex. Obesity, arthritis, other)

4. Non-segmented pneumatic compressor tried: yes or no, if yes when ________
   Sample Results: same as #3

Additional Information that Applies to Venous Stasis Ulcers and Question #3 on CMN being answered YES

5. Ulcer has to be present 6+ months, when ________
6. Etiology is lymphatic and/or venous (circle one or both)
7. Compression bandaging tried: when ________
   Types tried and results: unna boot, ace bandage, tubigrip, setopress, comprilan, rosidal, other. See sample results from #3 (circle which ones)
8. Pharmacological tried: yes or no, if yes when ________
   Types tried:
9. Painful focal lesion located ____________. As a result, pressure in chambers ________ may be reduced or omitted in order to effectively treat the painful area.

10. Adverse symptoms brought about by the lower-end compression pump
   Sample results: pain over sensitive skin or ulcer in the ______ area, can not fit into sleeves due to girth of legs or arm, pain, numbness, tingling or loss of feeling.
What is Pneumatic Compression Therapy?
An aggressive, non-invasive, therapy of gradient, sequential pattern of compression used for the treatment and management of lymphatic and venous disorders. Therapy entails a physiologic milking action of the Lymph-edematous limb(s).

Who is a candidate for Pneumatic Compression Therapy?
1. Primary lymphedema is related to a development abnormality in the lymphatic system.
   a. Congenital (Milroy’s Disease)
   b. Proximal Obliteration
   c. Distal Obliteration

2. Secondary Lymphedema is the most common form of lymphedema and usually presents as a sequel to oncologic surgery
   a. Post-Mastectomy
   b. Post-Lumpectomy
   c. Groin Dissection

3. Venous Disorders
   a. Chronic Venous Insufficiency
   b. Crural Ulcer

4. Dysfunctioning Muscle Pump
   a. Paralysis of Lower Limbs
   b. Muscular Contractions

What are the benefits of Pneumatic Compression Therapy?
Patients with either primary or secondary lymphedema develop an insufficient number of lymphatic vessels and nodes for fluid transport. The resultant accumulation of lymph fluid in the subcutaneous tissue and skin leads to a cosmetically displeasing enlargement of the extremity, but limb heaviness and a predilection for recurrent infections also limit the lifestyle of the patient with lymphedema.

By stimulating the lymphatic and venous systems, the stagnant fluid is pushed through the vessels, allowing the venous system to resorb the fluids and helping to develop collateral channels through which the fluids can begin to flow.

How will the patients receive training?
Our experienced staff of healthcare professionals provide timely, efficient service to meet your patients personal medical needs. A healthcare professional will fully train your patient to use compression
instruction as needed. Training is not completed until the patient has demonstrated to us that he/she understands how the equipment works and can safely administer the therapy.

**How is the cost of Pneumatic Compression Therapy paid?**
Costs for pneumatic compression therapy modalities are covered if the patient carries private insurance, Medicare Part B, or other supplemental insurance plans. Our policy is to attempt to confirm insurance coverage prior to providing services to your patient. This will eliminate any unexpected costs or surprises. For the patient’s convenience, we directly bill the insurance provider. The amount billed is in accord with Medicare reimbursement guidelines to insure a competitively priced product/service for your patient.

**What are the contradictions?**
1. Non-compensated congestive heart failure
2. Acute deep vein thrombosis of a recent nature
3. Pulmonary edema
4. Acute phlebitis
5. Acute infection
6. Peripheral arteriosclerosis

**With all the Pneumatic Compression Therapy pumps available today, how will I know which one to choose?**
Many changes have and will continue to occur within the industry. Our prominence within the industry enables us to be in the forefront to receive new HCFA policy and regulation, as well as actively participate in these decisions.
As specialists, we have evaluated the most effective modalities, and are able to provide a full line of products to serve all your patients (i.e., deformities, obesity, amputee, etc.) We work together to assure that with the right modality, quality patient care and effective follow-up, therapy is successful.

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