An extensive literature search was completed using the following key words: amputation, amputee, below knee, edema, elastic bandage, gait, knee flexion contracture, incision, prosthesis, prosthetic fitting, range of motion, rehabilitation, removable rigid dressings, residual limb, shaping, soft dressings, swelling, tensor bandage, volume, wound.

The literature review revealed a lack of consistent and comparable research available across the continuum of amputee care. Few level A, RCT studies are available. As well, the outcomes that are measured vary, for example defining readiness for prosthetic fitting, or functional use of a prosthesis. This makes comparing results difficult. Finally, authors note the challenge of small sample sizes and the impact of this on establishing significant findings. Of the articles selected for use in this document there were 2 cohort studies, 3 RCT’s, 3 critical/systematic reviews, a case audit, a retrospective analysis and a summary article. Also published guidelines from both the US and Britain were considered.

The literature review revealed a number of themes:

- Residual limb edema has negative effects on residual limb healing, shaping and readiness for prosthetic fitting: Several of the authors identify that edema compromises wound healing and may cause pain. As well edema can lead to poor residual limb shaping and maturation. This leads to delay in readiness for prosthetic fitting, and thus prolonged return to ambulation and previous activity. Edema management should be a priority.\(^1,2,3,4,5,6,7\)

However,
there is limited explanation by the authors as to why edema has negative effects. Nawijn et.al. state that “in the absence of edema a maximum of capillary blood supply is available for the healing process of tissues, therefore improving wound healing.”

For further explanation consideration to the International Interprofessional Wound Care Course curriculum is helpful. Fowler and Carson identify that edema leads to poor epithelization, decreased oxygenation, nutrition diffusion and immune response. As well, a transtibial amputation involves the use of a posterior flap approach to cover the distal tibia. Rund and Kane report edema is one of several local factors that impact the healing process of surgical flaps and that “every effort must be made to reduce excessive tension on flaps.”

- There does not appear to be consensus regarding post-operative dressing choices: The purpose of the post-operative dressing is to control edema, promote wound healing and residual limb maturation and shaping, and to avoid the development of knee flexion contractures. The choice of dressing may depend on resources, time and expertise. Orthopedic surgeons appear more likely to use a rigid dressing than vascular surgeons.

- A rigid (plaster or fiberglass) applied to the transtibial amputation immediately post-operatively appears to have several benefits and is the method of choice: Post-operative casting helps to reduce and control residual limb edema and initiate good residual limb shaping in preparation for prosthetic fitting. It may reduce wound healing time and incision breakdown allowing quicker initial fitting. When applied above the knee with full extension this limits the risk of knee flexion contractures. The use of a total contact cast is not exclusive to amputation. A
properly applied and monitored cast is considered gold standard in the treatment of non-infected, non-ischemic diabetic foot ulcers.\textsuperscript{13} It stands to reason that this approach is appropriate in the case of transtibial amputation. Bowker et. al. includes this approach in their description of transtibial amputation surgical procedure and immediate postsurgical management. \textsuperscript{14}

- There is limited research and a lack of consensus regarding the most appropriate residual limb and shaping method in the sub-acute phase once the immediate post-operative dressing (rigid cast or otherwise) has been removed: Fowler and Carson report “edema, regardless of cause, is due to capillary filtration overwhelming lymph drainage for a sufficient period of time. Treatment should be directed toward improving venous and lymph drainage.” \textsuperscript{9} This involves compression, leg elevation, exercise and good skin care. They indicate that elastic bandages provide mild to moderate compression when applied correctly, but that proper application and the need for frequent reapplication can be problematic. Elastic tapered or tubular provide light compression (though applying additional layers will increase compression) and may be a more easily applied, cost-effective alternative. Manufactured hosiery is another option. Elevation and exercise prescription are recommended as well. All of these options exist for the transtibial amputee. The same challenges exist regarding the difficulty of proper application and frequent reapplication, and patient adherence. The evidence supports that the application of elastic bandages can assist with volume control
and shaping but it requires skilled technique. Without appropriate application there is the risk of too much proximal compression, tissue strangulation and pressure damage, though these complications are not well documented. \(^3,^{15}\)

- **Amputee care benefits from a specialized interprofessional team approach and collaboration across the continuum of care:** The lower extremity amputee is typically a complex patient with multiple care needs. Achieving the best outcome for these patients is supported by the efforts of a specialized health care team to advocate and communicate on their behalf. \(^{11,16,17}\)
### Transtibial (Below Knee) Residual Limb Edema and Shape Management Recommendations: INPATIENT REHABILITATION

#### ADMISSION:
- Patient will arrive with the method initiated in acute care.
- Further decision-making should be collaborative by the team, including the patient.
- Patient provided with written and verbal education and support to implement shaping.
- Ensure referral to specialized amputee team has occurred.

#### DISCHARGE:
- Ensure patient has appropriate education and instructions.
- Ensure patient is aware that shaping/edema management and independent exercise is to continue upon discharge.
- Ensure patient is has contact information for the specialized amputee team and is aware of any scheduled appointments.

### Tensor Banadaging:
- Tensoring should only be introduced if the patient or primary care giver is able to demonstrate appropriate, safe technique.
- Figure-8 approach, full coverage of the residual limb, moving from distally to proximal, wrapped above the knee, never below (to avoid compression to the popliteal fossa).
- Tape of Velcro closure only, no sharp closures.
- The tensor must be removed and reapplied a minimum of 4 times per day, more if the tensor shifts or becomes uncomfortable.
- Tensoring must be stopped and an edema/shape management reassessed at the first sign of a bandage abrasion (most often to the popliteal fossa), impaired wound healing or other skin breakdown.

### Tubular elastic compression stockinette:
- Width selected based on size of patient limb (most often 3-5 inch wide). Ie Elastogrip, Knitrite
- Closed at the distal end sewn or tightly tied.
- If the patient tolerates: double layer elastic compression stockinette.
  - Two layers stockinette, first layer being longer than the outer/second layer (creating a pressure gradient)
  - Stockinette is sewn asymmetrically.
  - Longer side applied first.
  - Second layer folds back over the first.
- Stockinette must contact end of residual limb (No pocket at the distal end).
- Length allows for stockinette to be pulled a minimum 5 inches/13 cm above the knee (avoiding compression through the popliteal fossa).
- Stockinette should be repositioned regularly to avoid it slipping down/wrinkling.
- Replace or wash when soiling occurs.
- Patient may be provided with 2-3 that can be hand washed.
Transtibial (Below Knee) Residual Limb Edema and Shape Management Recommendations: INPATIENT REHABILITATION

**Manufactured Compression Sock:**
- Juzo, Kniterite.
- Available from the certified prosthetist.
- Requires accurate measurement by the prosthetist or trained physiotherapist to ensure proper fit.
- Cost to patient approximately $50-70.
- Must be pulled enough to ensure contact with the distal end of the residual limb (no distal pocket).
- If able, patients should purchase 2 socks to allow washing.

**Seating and Exercise:**
- Seating and positioning re-assessment and prescription occurs at time of admission.
- Amputee board used to encouraged knee extension, reduce knee flexion contracture risk, manage edema and skin integrity, control pain.
- Patient educated about the impact of residual limb edema on wound healing, pain and prosthetic fit.
- Patient educated and of importance of elevation of the residual limb, AROM exercises, particularly for hip and knee extension strength and ROM.

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