

TOTAL CONTACT CASTING

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Total contact casting (TCC) was first introduced in 1930s by the orthopedist Milroy Paul in Sri Lanka for of treating non-healing ulcers in Hansen's Disease. Paul Brand used the technique for similar patients and after several modifications, brought the technique to the United States in the 1960s. Although variations in materials have occurred, the concepts and principles of TCC are basically the same.

INDICATIONS

Indications for TCC are: chronic non-healing ulcers associated with neuropathic disorders of various etiologies including diabetes mellitus, leprosy, back injuries, reduction of foot and lower leg edema, allowance for consolidation of the Charcot foot (neuroarthropathy), and postoperative adjunct to reconstructive surgery.

CONTRAINDICATIONS AND COMPLICATIONS

Contraindications and complications include active infection, poor pedal hygiene including onychia and elongated nail, ischemia, non-compliance, and claustrophobia. With respect to infection, the dark, moist and warm atmosphere within this cast is an excellent environment for bacterial growth. Other forms of unloading should be used until the infection is resolved before TCC application. Nails should be trimmed, as long nails with severe incurvation can cause nail lysis and obvious paronychia problem. Xerotic skin should be treated with emollient lotions to avoid fissuring and hyperkeratoses if present, debrided. Circumferential bandages should be avoided. Cutting of the bandage into skin can occur reducing blood flow to the foot. As Kominsky states "It is far more important to be concerned with what is taken off of the ulcer, i.e., pressure, than what is being put on."

Prior to cast application the ulcer should be evaluated for width and depth. Ulcers that are deeper than they are wide create a problem since epithelialization may occur before the depth of the wound is adequately healed, possibly allowing an abscess to form. These ulcers should be uncapped, treated with open packing then casted.

Extrinsic complicating factors include improper removal of the cast. Over aggressive use of saws and scissors can create abrasions and possible new sources of infections and ulcers. Practice in cast removal is paramount prior to attempting to remove TCC especially in neuropathic patients. Indentations in the casts when patients ambulate prematurely can create depressions in the cast that can become new pressure ulcers. For this reason patients need to wait 30 minutes or longer when synthetic cast are used and 24 hours when plaster casts are used prior to placing full weight on them.

BIOMECHANICS

TCC works because it diminishes pressure on the wound, increases the surface area on the plantar aspect of the foot and limits all muscle-tendon activity. Ulcers on the plantar aspect of the foot are formed as a result of abnormal stresses, usually from bony prominences. TCC causes the patient to shorten his/her stride length, which in turn reduces gait velocity and therefore reduces vertical loading forces on the foot. Sagittal plane motion at the ankle is eliminated thereby eliminating the propulsive phase of gait. As a result the vertical loading forces are eliminated at the metatarsal heads. Once these forces are absent, ulcers in the sub metatarsal head area become unloaded and given a chance to heal.

Application of casting material to the entire skin surface of the foot and leg creates significant contact surface area which can reduce vertical forces at the site of the bony prominences and reduce edema significantly. Edema reduction can be dramatic in the first two days. If the cast becomes loose, pistoning of the extremity occurs within the cast, which in turn can cause a new ulcer. The cast therefore needs to be changed. Although compared to complete bed rest, crutches, various shoes, orthoses, and pads, TCC reduces the need but does not completely eliminate the need for compliance.

CAST APPLICATION

Application of the cast should be as quick and smooth as possible to avoid lamination and thus weakening of the cast. We find that placing the patient prone is the easiest

way to apply the cast as this avoids the assistant and/or operator from having to hold the extremity off the table. Also the patient is more comfortable as he/she will not get cramps in the thigh or hip. The prone position allows the assistant to hold the appropriate position of the foot to the leg, usually ninety degrees to the leg. This position also allows the gastro-soleus complex to shift proximally on the leg thereby removing their bulk allowing for the cast to fit more snugly.

The assistant is of key importance in successful application of a TCC. Any abnormal movement of the extremity while the cast is drying can be detrimental as a new point of pressure may be created, which can cause a new ulcer. Loss of position can also alter weightbearing so that inappropriate pressure is placed on the plantar aspect of the foot. This is not a procedure for the casual assistant!!

MATERIALS AND SUPPLIES

- 3" or 4" stockinette
- 1-1" tape
- 1/4" adhesive felt- 4" wide x 20-30" long.
- 3" or 4" webril
- 1-3" roll plaster casting tape
- 2-4" rolls plaster casting tape
- 1-2" roll synthetic casting tape
- 1-3" roll synthetic casting tape
- 2-4" rolls synthetic casting tape
- 1 walking heel
- silicone (clear-site) protectors
- foam toe protectors
- precut plywood foot plate

PROCEDURE

Total contact casting is a precise procedure that requires skillful application. The surgeon should attend a hands-on course and practice applying 3-4 casts prior to putting one on a patient. The ulcer is debrided in standard fashion and if a dressing has to be applied, it is held in position with one inch paper tape. Circumferential dressings are not recommended for reasons previously discussed. The patient is placed in the prone position (Figure 1A). Bony prominences, and the posterior heel and achilles tendon are padded (Figure 1B). One fourth inch adhesive felt is applied to the leg and foot starting anteriorly on the tibial tuberosity crossing the ankle, ending on the dorsum of the foot (Figure 1C). Alternatively in sensate patients, the felt can be applied to the medial and lateral aspects of the leg and foot. Stockinette smaller than the size one would normally use is placed from the toes to just below the knee. One to two

inches are left past the toes, folded dorsally and held in position with one-inch tape. Folds are created at the ankle and the excess material is cut away and the ends of the stockinette are taped with one inch tape (Figure 1D). One fourth inch foam is placed over the toes and past the metatarsophalangeal joints dorsally and plantarly to protect the toes and limit MPJ tendonous motion (Figures 1E, 1F). The assistant stands lateral to the extremity and holds the foot 90 degrees to the leg while the knee is flexed 90 degrees. One thin roll of webril is snugly placed over the foot and leg with minimal overlap. One or two rolls of plaster rolls are placed from the distal aspect of the toes ending just below the fibular head. Note that the toes should be fully covered with the plaster so that they do not move once the cast dries (Figure 1G). A 5" x 30" splint double folded at the distal 1/3 is now applied plantarly from the toes ending posteriorly on the leg (Figure 1H). The precut plywood is placed on the plantar aspect of the foot (Figure 1I). It should at least meet the entire plantar aspect of the foot (Figure 1J). Multiple precut 3" to 4" pieces of plaster material are used to fill voids in areas where the foot does not meet the wood so that ABSOLUTELY NO ROCKING of the wood on the foot is noted (1K). Four-inch synthetic rolls are used to cover the foot and leg. The walking heel is centered in the middle of the foot in a line just distal to the long axis of the tibia (Figure 1L). The foot and leg are held in this position for a minimum of 5 minutes to allow the cast to dry. The patient may now be placed in the supine position and sits for another 20 minutes while the cast dries. It is preferred to maintain non weightbearing for 24 hours until the cast sets up well. The cast is changed as often as necessary but at least weekly to check for healing and other ulcer formation.

CAST REMOVAL

Cast removal should be performed by an operator that is completely familiar with cast saws and cast removal. A small nick on the skin may have severe consequences. A heavy marking pen may be used to place a line exactly where the doctor wants the cast to be split (Figures 2A, 2B).

SUMMARY

TCC is an excellent procedure for healing foot ulcers. It is my feeling that any ulcer that has some vascularity can be healed with TCC. It is skillfully demanding and requires practice to expertly apply it. It is preferable to have an assistant that has had hands on experience with application, holding and removing of TCC for best results.



Figure 1A. Patient in prone position. Knee and ankle are flexed 90 degrees . This position is easier for the patient and surgeon for cast application.

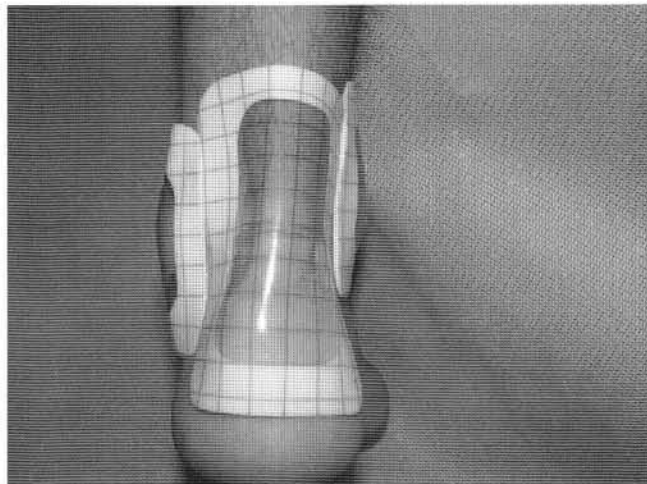


Figure 1B. Medial and lateral malleoli, posterior calcaneus, and distal 6 cm. of tendo-achilles are padded to avoid pressure ulcers. Photo shows Clear Site covering these areas.

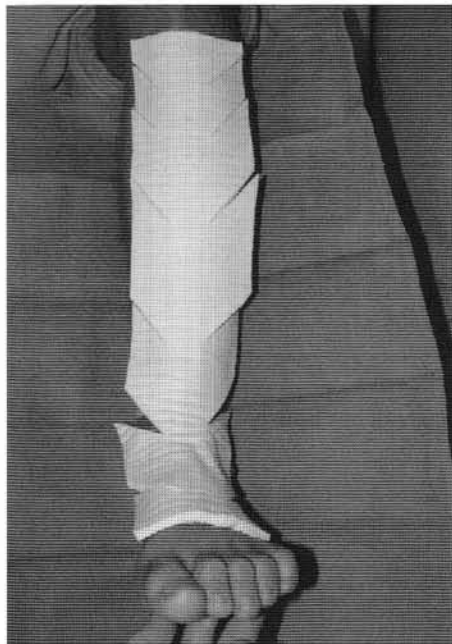


Figure 1C. Angular cuts are placed in the 1/4" felt which allows for better contouring when placed on the anterior leg, ankle, and dorsal of the foot.

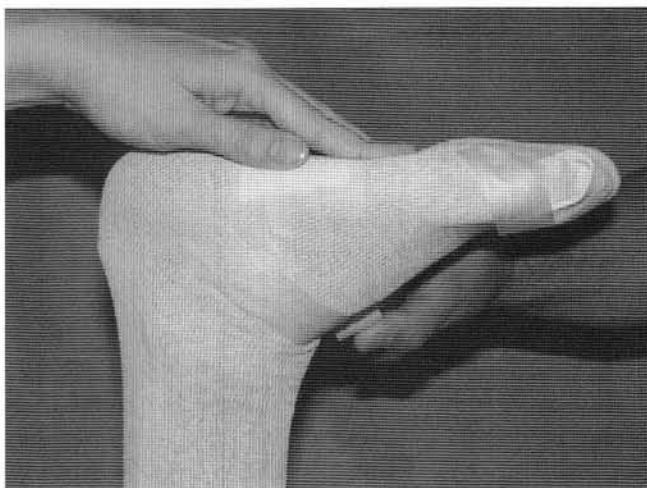


Figure 1D. Stockinette is folded dorsally over the toes and secured with one 1" tape. After the fold on the anterior ankle is removed, 1" tape holds the edges apposed.



Figure 1E. Plantar view showing one fourth inch adhesive foam placed over the toes and MPJ's to avoid pressure.

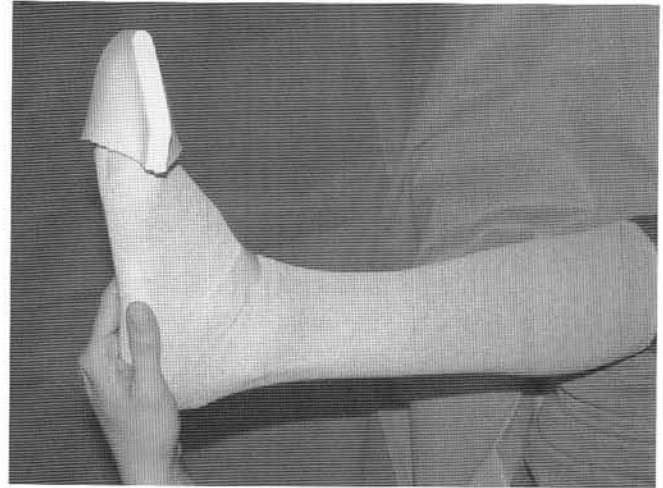


Figure 1F. Lateral view showing foam as in 1E.



Figure 1G. The entire foot and lower leg will be covered with plaster.



Figure 1H. 5" x 30" splints folded at the distal 1/3 and doubled on itself and then applied to the plantar and posterior aspects of the foot and leg.

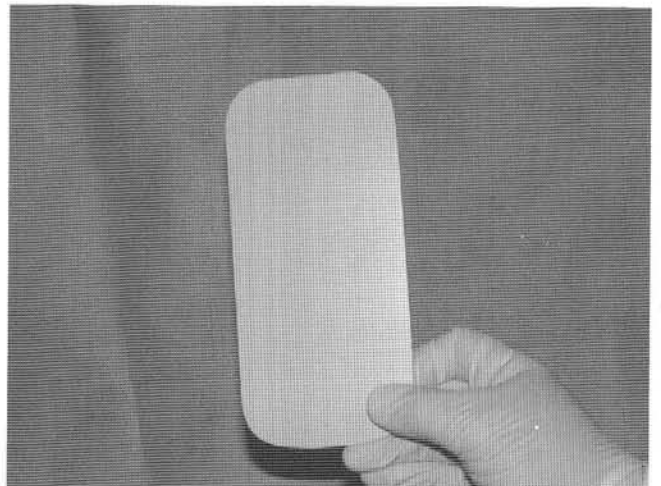


Figure 1I. Pre-cut plywood will be applied to the plantar aspect of the foot.

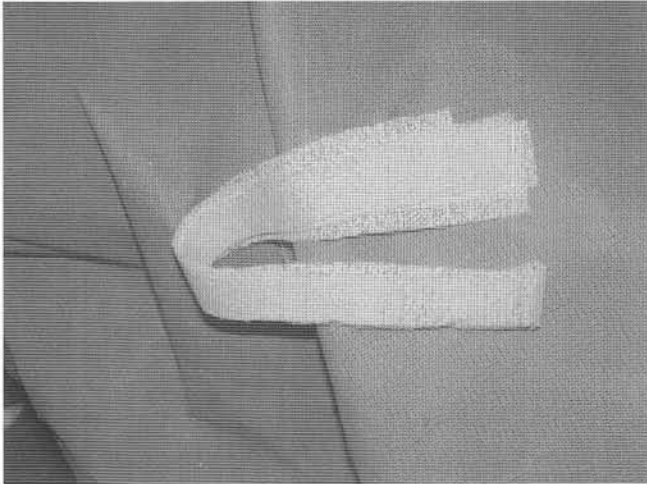


Figure 1J. Segments of plaster which will be applied to the plantar of the plywood.



Figure 1K. The precut plywood applied to the plantar aspect of the foot is further stabilized by adding portions of plaster where openings are present between the foot and the plywood to minimize movement.



Figure 1L. Lateral view of completed cast showing walking heel incorporated into the cast.



Figure 1M. Anterior view showing finished cast with walking heel.

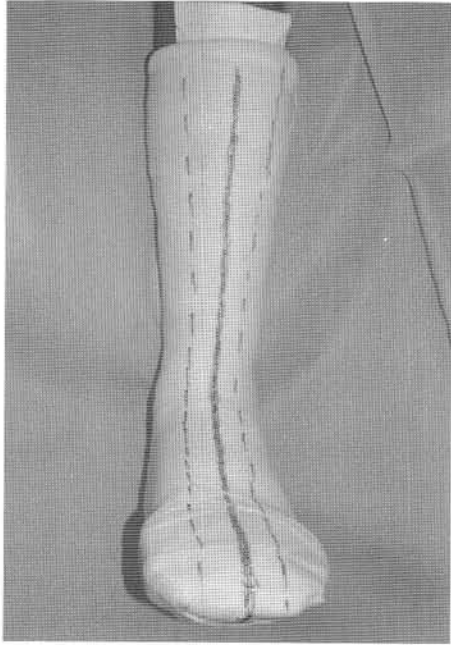


Figure 2A. Dark lines mark the areas of cast that will be split. The lines fall over the 1/4" felt applied to the leg and foot. Cast is removed either at the solid line or by cutting out a strip as outlined by the outer broken lines.



Figure 2B. Extremity after removal from cast.

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