

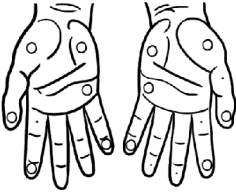

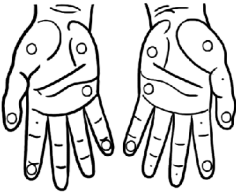
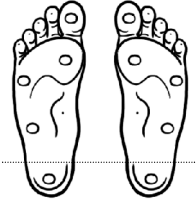
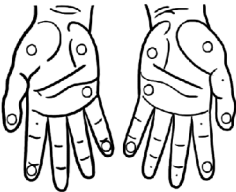
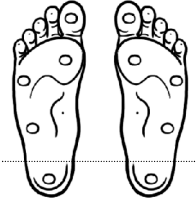
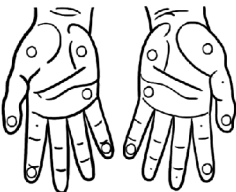

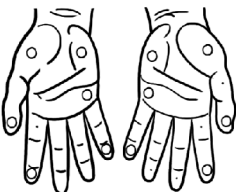
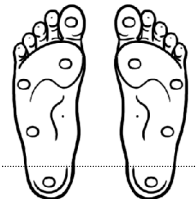
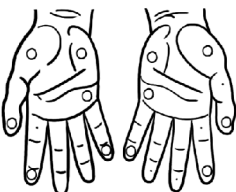

Appendix

- A Voluntary Muscle Testing (VMT)
- B Sensory Testing (ST)
- C Skin Care/Self Care Training
- D Removable Modified Total Contact Cast
- E Trial Walking
- F Eye Surgery Assessment (tendon transfer)
- G Hand Surgery Assessment (tendon transfer)
- H Foot Surgery Assessment (tendon transfer)
- I Trans Tibial Prosthetic Measurement Form

Appendix B

Sensory Testing

Other impairments:) =absorption; C=clawing/contracture; // = cracks. For wounds : draw to size

		<p>Date:</p> <p>Regular blink: yes / no</p> <p>If no: comment on completeness, Bells' phenomenon, corneal sensation:</p> <p>Comments:</p>
		<p>Date:</p> <p>Regular blink: yes / no</p> <p>Comments:</p>
		<p>Date:</p> <p>Regular blink: yes / no</p> <p>Comments:</p>
		<p>Date:</p> <p>Regular blink: yes / no</p> <p>Comments:</p>
		<p>Date:</p> <p>Regular blink: yes / no</p> <p>Comments:</p>
		<p>Date:</p> <p>Regular blink: yes / no</p> <p>Comments:</p>

Appendix C

G. Warren

Skin Care / Self-care Training

Individuals with insensate limbs need to know basic rules of self-care. The main problem is the sensory impairment, which eliminates the 'self protection' reflex. These people need to realise that prevention of impairments is possible. Anybody with (sensory) neuropathy, irrespective of the cause, requires the same basic care if they are to keep their limbs useful and functioning.⁵ This includes skin care, removal of callosities and prevention of trauma, including suitable footwear.

Patients with sensory impairment should:

- a. Inspect hands feet daily for symptoms i.e.: redness, swelling, raised temperature, blisters, cracks, ulcers, and then ask: How did this happen? What can I do to prevent it getting worse? The patient needs to learn to use his eyes as a substitute for loss of protective sensation.
- b. Never walk barefoot.
- c. Preferably wear socks as these reduce the chance of minor trauma. They also reduce dehydration of the skin that may occur in hot dry climates. Two pair of socks are better than one pair as any friction is dissipated between the two socks.
- d. Use gloves to protect hands during rough work or when in contact with hot objects.
- e. Be taught how to select suitable shoes from the local market, especially how to find soles that have suitable resilience, not softness.
- f. Check socks and shoes routinely for any irregularities that may harm the foot i.e.:

repaired holes, seams, stitching, foreign bodies and worn insoles.

A patient with neuropathy must learn that good footcare and footwear are essential if (s)he is to continue walking.

Footwear should have:

1. Tough soles to repel stones, tacks and thorns;
2. Resilient insoles to cushion the sole especially when it is scarred or there is atrophy of the small muscles and hence loss of padding and
3. Adequate uppers that are secured on the feet by laces, buckles or Velcro.

In addition the footwear should be socially acceptable.

In some cultures only sandals are the common footwear. Persons with insensate feet have been known to continue walking unaware that the sandal has fallen off. It is important that in those instances sandals have a heel counter. This may be in the form of straps, or be an actual heel in the sandal. Sandals without a heel counter are kept on the feet by contraction of the intrinsic muscles. These may be paralysed when there is a neuropathy. Often the person is not aware of this. Every clinic should have samples of suitable footwear and insoles that are available locally, or be able to provide information where it can be obtained.

Autonomic Neuropathy

With autonomic neuropathy there is alteration in the cycle of production and re-absorption of sebum and sweat. Initially these are still produced but not reabsorbed into the skin. Therefore it is not uncommon in BT/TT leprosy to find a build up of sebaceous material. If allowed to collect uninhibited it can fill the pits of the sebaceous glands and provide a breeding ground for infections. Removal often requires a solvent. A sebum build-up should be a warning that there is a relatively recent neural deficit.

When there is an acute autonomic nerve deficit the affected limb initially may feel warmer than the contralateral limb. It continues to secrete sebum and sweat. However after about 6-12 weeks the limb becomes cool and the persons with sensory impaired feet often complain of cold feet. The autonomic nerves also control capillary lability and when they cease to function the vessels no longer dilate under nerve control. However hyperemia still occurs as a physiological response to infection or trauma. Unfortunately many clinicians fail to accept this occurrence in the autonomically affected limb, and claim that the autonomic impaired limb is warm and if it is cool it shows a poor blood supply. Far from it, the coolness in the autonomically impaired limb often occurs because of the presence of an A-V shunt, and may be associated with distended veins. It has been shown that in people with diabetic neuropathy, the blood passing through the affected foot may be 5 times the amount that passes through a normal foot.¹ The foot has adequate capacity to become hyperemic if infection or trauma occurs. The significance of the alterations in the sebum and sweat cycles is that the skin becomes abnormally dry. A moist sweating foot usually has adequate sensory perception to protect from trauma. Therefore the presence of a dry foot may be a warning that neural impairment is present.⁵

Prevention of neuropathic foot problems- The effects of callous

The natural response of a limb is to produce callous to protect the skin from trauma during use. The neuropathic limb produces more callous than usual. Callous that is well hydrated is supple and pliable but when it becomes dry it becomes hard and un-yielding and may tend to split and crack. As it builds up it produces pressure and local hypoxia or anoxia of the deeper tissues until an ulcer occurs. Cracks will not heal till the callous is removed and the area rested. The most effective way of immobilization and obtaining healing of ulcers/cracks is by the use of the Total Contact Cast (TCC).^{2-4,7,8} If the skin is adequately hydrated the callous may remain moist and less likely to crack and while moist the callus can be easily trimmed.

Callous is a response to excessive pressures and friction and stress. It may not be possible to prevent callous build up but it is possible to ensure that it does not develop thick plaques and hard rough lumps.

A daily routine has been developed that *has proved effective* in many countries and has greatly reduced foot problems, especially ulceration. Every patient needs to be responsible for the care of his own feet. They should know from the time of diagnosis the importance of skin care and ulcer prevention and that this is the owners' responsibility. If that is impossible, as in the elderly or sight impaired, a relative or spouse should take the responsibility.

The daily routine is "Soak Scrape and Oil"

1. The patient examines his feet to check what needs to be done.
2. The feet, and preferably the legs up to the knees, are soaked in plain, 'cool' water for about 15 minutes. This will rehydrate the skin, and make any callous softer. There is no need to add medication for routine use. If there is some complicating skin condition

some medication could be added. There is no advantage in adding emulsifier, as oiling after the soak will be more effective. While soaking, the patient should wash off dirt etc. Do not use a detergent as it dries the dermis. If soap is needed use oil based soap.

3. After the soak the patient should remove any rough callous or lumps. He is not to try and remove all the callous as that is the natural protection of the feet when it is spread evenly over the feet. It is best to keep one foot in the water while the other is being attended to, so that the second foot does not dry out before it is scraped.
4. Then oil should be rubbed into the skin, to prevent evaporation of the water that has absorbed into the skin. Patients are often given moisturising creams that are based on mineral oils. The human skin does not absorb mineral oils from the skin surface although it makes the skin feel smooth and oily. When observed closely, most of these creams, unless animal oils, do not go into the skin at all. Animal oils such as lanoline and fish liver oils are somewhat absorbed and these should preferably be used. However, these are relatively expensive and not always easy to get. Liquid paraffin is cheap and usually obtainable. If applied in adequate quantities it will prevent evaporation and keep the water in the skin. Avoid edible oils as these attract rats and cockroaches in developing countries.

The soaking of feet for leprosy patients was popularised by Paul Brand who recommended it about 50 years ago. It has stood the test of time and is available and affordable for all. Since then others have also emphasized the need for good foot care and elimination of mechanical problems in maintaining ulcer free feet.⁶

Scraping

When thick callous dries out it cracks. This may be the start of an ulcer. The removal of callous is essential in ulcer prevention. The callous should be trimmed when the foot is still wet. Many prefer to remove callus with the foot dry rather than after soaking. Dry removal tends to result in cutting the callus rather than scraping it off. This often results in a rough surface. Long practice has shown that using a sharp knife e.g. a surgical scalpel on a well soaked skin results in a smoother and more effective scrape. The knife is used with just a wrist flicking action and scraped off as one would use a safety razor. Callous should not be cut off with scissors or a blade as one would use a carving knife, as this leaves a rough surface which may predispose to ulceration. Once the initial mass of callous has been removed it is possible to keep the foot in good condition by using a green nylon (not metallic) pot scraper, a pumice stone or similar material. In some countries the best material is baked brick. Do not use sandstone as it leaves the grains in the skin or wounds. In the Indian subcontinent the baked clay foot scrapers are effective if rough enough. If one of these 'scrapers' is rubbed on the wet callous every day it should keep the level of callous to a safe thickness.

There are clinicians that object to self-care, but it is necessary as worldwide and certainly in most leprosy endemic countries there is a shortage of 'foot specialists'. Even in 'developed' countries, a patient as a routine can only be seen every 6-8 weeks. This is not acceptable for a patient with a neuropathic foot who already has callous. In three months time they may have an ulcer that could have been prevented. The patient should scrape as soon as there is any hard skin. He should be instructed at the same time how to do it himself. If the patient or relatives are taught properly they ought to be able to keep the feet in good condition. Feet should be checked at every clinic

362 Surgical Reconstruction & Rehabilitation in Leprosy

visit. Every clinic worker should be able to show and instruct self care.

CONCLUSION

It is necessary that the patients learn that the future of their feet and hands depends on the patient himself and the care they take of them. Patients need to know that they can minimise the development of deformity and disability.

THE DAILY CARE OF NEUROPATHIC LIMBS DEPENDS ON THE PATIENT UNDERSTANDING THE NEED TO REHYDRATE THE SKIN, REMOVE CALLOSITIES, APPLY OIL AND WEAR PROTECTIVE FOOTWEAR.

REFERENCES

1. Archer AG, Roberts VC, Watkins PJ: Blood flow in the diabetic neuropathic foot. *Diabetologica* 22:9-15, 1982
2. Armstrong DG, Stacpoole-Shea S: Total contact casts and removable cast walkers. *J Am Pod Med Ass*, 89:50-53, 1999 (Abstract)
3. Birke JA, Patout CA. The contact cast: an update and case report. *Wounds*, 12:26-31, 2000
4. Coleman WC, Brand PW, Birke JA: The Total Contact Cast. A therapy for plantar ulceration on insensitve feet. *J Am Pod Med*, 74:548-552, 1984
5. Coleman WC, Brand PW: The diabetic foot. pp. 1159-1181. In Ellenberg M, Rifkin H, eds. *Diabetes Mellitus*. 5th Ed., 1997
6. Delbridge L, Ctercteko G, Fowler C, Reeve TS, Le Quesne LP: The aetiology of diabetic neuropathic ulceration of the foot. *Brit J Surg* 72:1-6, 1985
7. Mueller MJ, Diamond JE, Sinacore DR: Total contact casting in treatment of diabetic plantar ulcer: controlled clincial trial. *Diabetes Care* 12:384-388, 1989
8. Myerson M, Papa J, Eaton K, Wilson K: The total contact cast for management of neuropathic plantar ulceration of the foot. *J Bone Joint Surg*, 74A:261-269, 1992
9. Sinacore DR, Mueller MJ, Diamond JE: Diabetec plantar ulcers treated by total contact casting. *Phys Ther*, 67:1543-1549, 1987

Appendix D

G. Warren

Removable Modified Total Contact Cast (TCC)

The following guideline enables the health worker to make a Removable Total Contact Cast (RTCC).

The standard TCC is made with minimal padding (bony prominences such as malleoli) so that there is a complete inability to move any part of the limb inside the cast. Immobilization is essential for the healing of fractures. It also assists in obtaining healing in the shortest possible time in soft tissue injuries or after surgery- especially in the sensory impaired limb.¹⁻⁶

Often clinicians are hesitant to prescribe TCC for fear that the cast may produce ulcers. However, if the casts are moulded carefully to the shape of the foot/lower leg there should not be any movement inside the cast and ulcers should not occur. If the foot is swollen, when the cast is applied, then friction could occur as the swelling decreases. For the above reasons the RTCC has been designed. The limb can be inspected regularly. When the cast is (re)applied it will still be in total contact with the leg. As any swelling subsides an extra thick sock can be applied to maintain total contact. To achieve this the cast is applied over a uniformly thin layer of compressed wool, which is later replaced by a thick sock when the cast is bivalved.

If the limb has a wound that requires dressing, a dressing is applied before the cast is constructed. The same sized dressing is used at each dressing change so that the cast still remains a TCC but the wound can be dressed as needed. When the wound has healed a simi-

lar dressing is still used to occupy the space and ensure the accurate fit.

A) Special Considerations

1. Minimal Padding

It is advisable to use stockinet, or a similar material, on the leg to hold any dressing, if still needed, in place and keep the plaster from direct contact with the skin. This is especially so with a fibre glass cast as this material can be very irritant and rough to the neuropathic skin. The polyurethane/resin casts (e.g. Dunacast pro) are 'softer' on the skin. If the cast is to be split, the stockinet can be placed over the layers of compressed wool and the stockinet will become part of the bivalved cast, serving as a lining on the finished splint. Do not use adhesive material on the skin, as it may produce an allergy or become loose, roll up, and create a pressure spot. A small amount of non-compressible material such as compressed wool, used to provide a double layer of uniform thickness inside the cast, makes friction spots during use and damage by the saw during removal of the cast, less likely. This wool should not compress enough to allow movement inside the cast if the cast is worn without bivalving. It is replaced by a thick wool sock after the cast is bivalved so that the cast is still fitting when it is replaced.

Stockinet placed over compressed wool can be used to hold in place any essential protective padding. The best padding is orthopedic felt of about 5 mm thickness. Moleskin, or micro-cellular rubber, can also be used.

Commonly used compressible foam is not recommended except for the top of the cast, as it compresses too much. Areas that may need some protective padding are: the top of the cast, the tibial crest, the malleoli, point of the heel, and the metatarsal heads or toe tips. If the toes are clawed use a pad on the dorsal surface to protect the interphalangeal joints from rubbing.

2. Any Plaster of Paris slab should be rubbed smooth before application.

This should remove rough ridges and small lumps of plaster that easily occur in a back slab. All plaster bandages should be rolled on carefully to avoid making one edge tighter than the rest. If polyurethane casting material is used, the reinforcing slabs are applied without wetting.

3. The position desired inside the cast is obtained by manipulation before cast application.

This position is maintained until the cast is firm.

The foot should NOT be manipulated after cast application when the plaster is wet. Trying to improve the shape after the plaster is applied is a very common cause of pressure points inside the cast.

4. Position for cast application

The patient lies face down on the table with the knee at 90 degrees (Fig. D-1). It is helpful to use a cotton bandage looped around the arch to ensure that the ankle is slightly dorsiflexed and in a functional position without inversion or eversion. This bandage can ensure good moulding of the arch together with the hand of the assistant. The fingers of the assistant also ensure that the MTP joints do not extend. The fingers on the dorsum allow the plantar aspect of the cast to be applied with the toes straight.

In badly deformed feet, such as those with multiple fractures, several cotton bandages can be used to 'mould' the foot in the desired position while the wet plaster is applied (see technique). The bandage is then cut off, at the edge of the plaster, not pulled out, before the cast is completed. If the foot requires reshaping it is wisest to do the primary cast with Plaster of Paris, not fiberglass or polyurethane. Plaster of Paris is far easier to work on deformed feet. The fibre glass is more difficult to smooth over irregular areas.

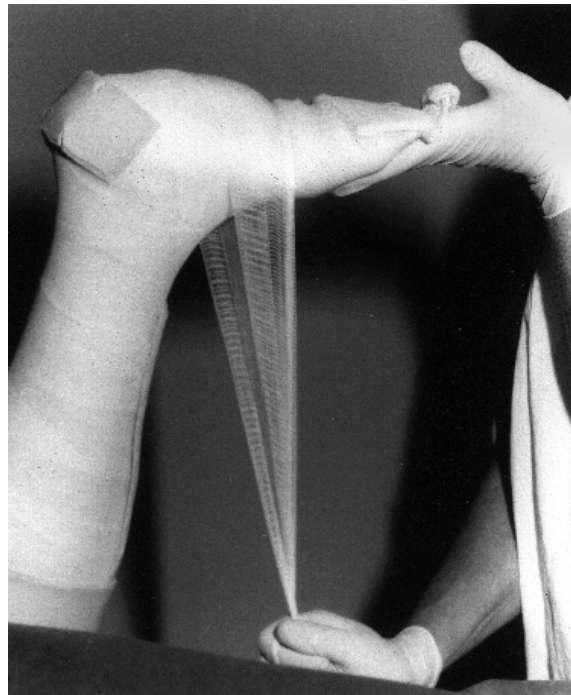


FIGURE D-1 Patient is in the position for application. The patient lies prone with the affected leg elevated so it is at 90 degrees to the table and the foot is parallel to the table. Note the bandage over the arch, the padding on heel and tibia and the fingers on dorsum as described in the text.

5. The sole of the cast

The sole of the cast should extend at least 1 cm beyond the toe tips to minimise trauma to the toes. The dorsal aspect may be left open if it is not essential that the toes are fully incorporated

in the cast. Make sure the sides of the cast in the metatarsal head area are not tight and compressing or constricting the toes.

6. Firm application

With ordinary plaster of Paris it means it should be applied with some tension over the calf and ankle. There is always some loss of muscle bulk early after application of a first cast and if the plaster is not applied firmly round the ankle and foot it will move with every step and may cause an ulcer. With elasticised plaster bandages some practice is needed to ensure the cast conforms well. The polyurethane bandages are slightly elasticised and this does help in making a good contact.

7. Complete drying

With plaster of Paris it is essential that the patient does not put the foot to the ground for 48 hours to ensure full drying. Drying is by chemical action and not influenced by heating or fanning. If walking is allowed before 48 hours the inner plaster shell may crack. This can cause localized friction or a pressure point. Polyurethane dries in about 20-30 minutes so the patient can leave the clinic walking soon after application.

B. Technique of application

1. The foot is cleaned and excessive callous removed

Any wound is cleaned and dressed. For a simple wound, the cast may well be a Total Contact Cast, not bivalved, at least not initially. Such ulcers can easily be left in the cast without inspection for 6-8 weeks and most will heal in that time. If an ulcer is present a single dressing square is used to cover the ulcer. Note the size of the dressing so that the same sized dressing can be used at every dressing change to ensure identical fit. If the wound is discharging or it is intended that the cast be bivalved for regular

dressing change a more bulky dressing may be used. Select a standard dressing size- e.g. 10x10 cm gauze and wool pad. Apply this with whatever medication may be needed. Do not pack the wound as the packing may produce a local pressure point. If the ulcer is deep or a sinus it can be loosely packed to assist drainage if the cast is to be bivalved and the dressing changed regularly.

2. The patient lies prone

The knee is bend at 90 degrees. The sole of the foot is parallel with the table top. This is the 'economic' position for the person applying the cast and the patient. During application it is essential that the foot is in a neutral position. Some dorsiflexion of the foot may further decrease pressures on the forefoot and mid foot. When the foot is 'boat-shaped' a Böhler iron might be better than a formal cast sole because the Böhler iron takes more of the patient's body weight through the lower leg.

3. Padding/protection

A stockinet is pulled over the lower leg and foot to hold any dressing in place. The stockinet must extend 5 cm beyond the toe tips to just above the knee. A uniform layer of webril (or compressed cotton wool, not foam) is wrapped around the leg and foot. While the webril is being applied make sure the ankle is in the correct position so the wool will not wrinkle when the ankle position is maintained. The wool will be replaced by a thick sock after removal of the cast.

Then pull on a piece of stockinet to cover the foot and leg as high as the knee making sure that it is not deforming the toes and that the webril and any dressing are lying smooth and flat under the stockinet. If the stockinet around the ankle is wrinkled cut it once and stick the cut edges together with adhesive tape.

A piece of suitable protective material (see paragraph A4 above) is stuck to the stockinet

around the malleoli and ankle and along both sides of the tibial crest, not right on the crest. The top of the cast, near the knee can be padded with layers of wool or compressed foam that will be turned over the cast. When the cast is bivalved this padding will be incorporated to be a permanent part of the finished cast.

4. Maintaining desired position

If the foot needs to be stabilized in a better position or if there is a fracture that needs reducing, then place a piece of cotton bandage (2-3 cm wide) about 45 cm long round the arch of the foot and tie it in a knot that leaves a big loop below the foot (Fig. D-1). The assistant can then easily stabilize the position of the ankle by pulling on the piece of bandage to keep the ankle at 90 degrees or less. In- and eversion of the heel and foot can also be controlled by pulling the bandage in this way. With the other hand the assistant can plantar flex the toes at the MTP joints (not IP joints), by having the fingers on the dorsum of the foot. If moulding of the arch is needed, the assistant can increase the arch by the degree of tension exerted on the bandage while applying counter pressure with the fingers flat on the dorsum. This should allow the person applying the plaster to make a well-moulded sole without needing to apply local pressure through the plaster. In other words the bandage held by the assistant and the assistant's hand on the dorsum, hold the position so the casting material can just be laid onto the sole of the reshaped foot and banded on and rubbed into the curves. In very deformed feet it may be necessary to have two or more assistants pulling bandages in various directions to correct the deformity before applying the cast.

Once the position is satisfactory, commence the actual application. The method will differ with the various materials available.

Plaster of Paris

- a) When Plaster of Paris (POP) is being used make a back slab. Use 15- 20 cm POP rolls and fold (dry) a backslab that extends from 1-2 cm distal to toe tips up to 5 cm below the knee. This needs 8-10 layers if NO fiberglass over-wrap, and 6 layers if fiberglass is used to reinforce the finished cast. Cut darts in it at the heel so it can be properly fitted without making lumps, or cut out wedges at the heel to leave the heel smooth.
- b) Wet the slab well and lay it on a flat table. Rub the plaster in well, making sure all the wrinkles and lumps have gone from the upper surface, and the cut darts are straight, and smooth to fit the heel.
- c) Apply the backslab onto the leg with the smoothed upper surface adjacent to the leg. Start at the toes and place the top (knee end) last. Rub the wet back slab into the arch of the foot and around the heel and sides of the Achilles tendon. Make sure the assistant holds the foot in the desired position. Carefully place the darts together so they make the heel fit without lumps. DO NOT push fingers into the wet plaster, as these may make dints and pressure points. Make sure the sides of the POP at the metatarsophalangeal area and toes are suitable, and protective. It may be most convenient to have the assistant have his little finger protecting one side of the foot and the thumb the other side so that the cast at the sides is not pulled in so tightly that it causes pressure. The cast must extend 1cm beyond the toe tips on the plantar surface when finished.
- d) Take a 10 cm roll of plaster bandage- soak it and start to wrap at the ankle (Fig. D-2). The first throw is passed across the front of the ankle so that the edges are away from the ankle crease and kept smooth. The raw end



FIGURE D-2 The backslab is in place and the plaster is rolled commencing at the ankle.

of the bandage is over the back slab on the point of the heel. Pass the bandage over the heel point and then back round the ankle and then work outwards making figures of 8 around the ankle. Do not remove the positioning bandage through the arch, or anywhere else till the plaster has dried enough to stabilise the position. Be careful not to make creases in the plaster. Work around the positioning cotton bandages. Wrap plaster bandage round the toes making sure that toes are straight especially at the MTP joints and that the toes are not cramped laterally. The plaster bandage needs to be put on fairly firmly. Apply some tension while unrolling and applying the bandage, especially around the calf and upper leg. It is not advisable to use elasticised plaster bandages as it is very easy for these to be applied too tight without causing pain in the insensate leg.

Polyurethane/resin

Note that fibre glass leaves a very rough surface and edges and easily damages atrophic or neuropathic skin. It should never be used directly on the skin. Polyurethane/resin bandages are not so likely to damage a-sensitive skin.

- a) To make the back slab take a 10 cm roll. Do not wet it. Use it dry to place over the foot in the position of the back slab. Ensure that the end reaches beyond the toes and let the stretch go before finalizing the length of the slab. The slab needs to reach from 2 cm beyond the toe tips to about 7-8 cm below the popliteal crease when the stretch has gone. Use about 6 layers and smooth it with your hand. Be careful that no one sticks fingers into the Polyurethane/resin bandages. Sudden dents and ridges make very rough areas next to the patient's skin. At the heel, smooth the excess on the sides to make a little pleat which is then cut flat so that the heel fits snugly.
- b) If using Polyurethane/resin take a 7.5 cm roll, wet it well, and start to wrap around the heel - being very careful with the first turn to go from heel point and fold the corners of the tucks into place without making rough bumps inside the cast. The narrower bandage is easier to apply, without wrinkles, than the wider bandages. It is essential that it is completely smooth as it is impossible to remove wrinkles later. From then on the application is much the same as for the POP cast but do not allow it to wrinkle around the bandage pulling the arch or foot into the desired shape. If necessary cut the polyurethane/resin bandage and start again at the toes.
- c) With the next 10 cm bandage start at the knee. Make sure the top is smooth. Cut off

rough cast if needed. Start at the back so the loose end is on the back slab and pull firmly. Pass three turns around the top and then spiral down the leg. Keep it very firm, and apply enough to make it strong. Turn the wool and stockinet down over the top of the cast and fix it with the next roll of plaster which will continue to spiral down the leg. Take up any slack bandage on the back of the leg and not on the front where a lump may be left. The fit of this is critical in making a true TCC. If using POP, when the leg piece is complete, use the palms of both hands to lift the plaster carefully off the tibia, by pressing in from both sides to relieve any pressure over the tibial crest. This cannot really be done with polyurethane/resin bandages and one needs to rely on the pads on either side of the tibial crest. Continue by completing the foot section. Cut off the bandage over the arch that was used for positioning. Do not try and pull it out. Complete the section over the arch with figures of 8 around the ankle and arch, and increase the strength around the toes and then turn back the stockinet at the toes. Make sure that there is adequate POP on the sole and ankle to allow walking and prevent ankle cracks. If the foot is rocker bottomed or the ankle is fixed in plantar flexion so that the sole is not basically flat, plantar grade and convenient for walking, the discrepancy ought to be corrected by a wad of POP, on the heel usually, before the final coat of casting material is applied.

d) If fiberglass or polyurethane is put on top it adds a lot of strength and helps protect from excessive wetting in bathrooms and rainy weather. There is no need to fill in the arch, provided adequate thickness of plaster has been applied. If the foot was held in correct position the patient ought to be able to walk on this cast with or without an overshoe. It

is better to walk on the straight plaster or in an overshoe than to apply a walking heel as the heel increases the leg length discrepancy. If a rubber heel is fitted into the arch it may push into the cast (especially a cast made of POP) that gets wet due to rain, floods, humidity or just carelessness, and cause local pressure over a relatively small area of the arch.

Insist that "NOT ONE STEP " is taken for 48 hours to ensure full drying of the thick POP cast. Putting the foot to the ground for standing at toilet or using the foot to weight-bear during "transfer from bed to chair" is counted as a step! Movement during drying results in cracks. For the patient with two casts applied on the same day it is preferable to insist on complete bed rest for 48 hours to ensure drying without cracking. It is better to wait longer. When using regular POP it is better to wait longer, say 72 hours or even a full week before bivalving.

When Polyurethane/resin is used the cast will be dry enough in half an hour for cutting or for walking.

a) Bivalve the cast, a little anterior to the mid-lateral line. Be careful at the malleoli to ensure you will be able to remove both pieces without destroying either (use an electric saw). You will need to cut the stockinet in the same line, with scissors. Try not to remove the stockinet that is attached to the POP, so do not pull and tug at the cast to remove it. The stockinet should be stuck to the plaster over the calf at least, and will provide a protection from putting the plaster directly against the skin. By using two layers of stockinet where there are dressings, it should be easier to remove the cast without breaking the cast or damaging the patient's skin. The adhesive moleskin, or other padding should be attached between

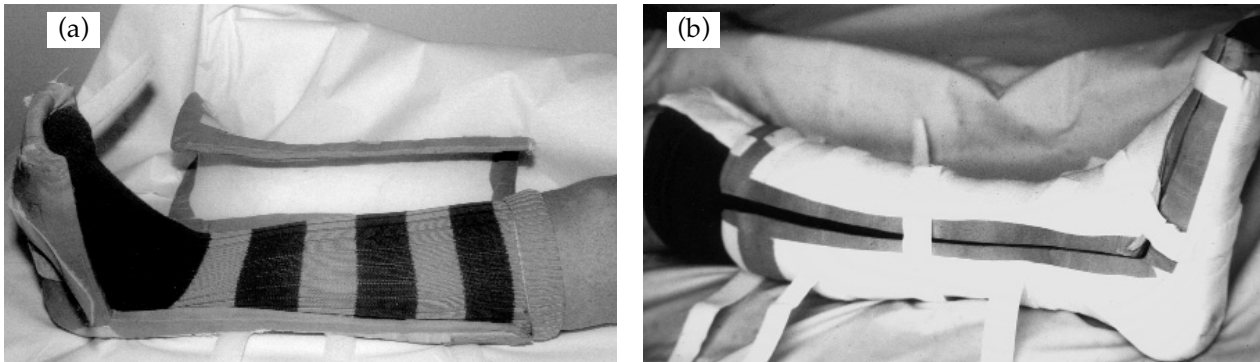


FIGURE 3 a. A bivalved TCC showing the adhesive tape sealed edges and the foot, in the football sock, lying in the back slab part. The front half is lying alongside, ready to be applied. **b.** The two parts of the slab put together with Velcro tapes around that are not yet tightened.

the plaster and stockinet, to provide protection for as long as the cast is in use.

- b) Use adhesive tape (sticking plaster) to seal all the edges. This will eliminate roughness that may traumatise neuropathic skin and it keeps the stockinet in place. If the stockinet is loose and cannot be smoothed into place remove it completely rather than leave it rough. If that occurs it is best to apply adhesive moleskin or similar direct to the cast to provide the recommended padding on pressure points. It can also be applied over any other rough points or over any site where friction may be occurring in the future or the plaster is rough. Make sure the adhesive tape catches the stockinet and wraps over the cut plaster edges.
- c) Use Velcro straps with or without rings, to make sure the two pieces are easily replaced in the correct alignment (4-6 sets of straps).
- d) Redress the wound with the same amount of dressing material. Then apply a length of tubigrip that is long enough to turn back over the toe and at the top. Alternately, a long sock (e.g. easily stretched such as thick football sock, or hiking sock that goes right

to knee) can be used to replace the original stockinet. It will also fill the space which was occupied by the compressed wool (Webril) and hold the dressings in place. It is much better than a bandage as it will provide uniform thickness and is less likely to wrinkle, especially if turned down at the top. Apply the two pieces of cast around the leg. Use two socks if the cast seems loose. Extra socks can be added from time to time as the edema lessens or the cast seems to become loose. Fix the Velcro tapes. Turn down the top of the sock, over the Velcro, to keep the top firm. Make sure the patient realizes that this also helps to keep the sock smooth inside and prevents a "concertina" effect of the sock under the cast

- e) If necessary wrap an elastic bandage over the whole cast to make sure it does not slip. Well-placed Velcro should eliminate the need for the bandage. Some patients prefer the bandage which is satisfactory if really firm, so should not be an elastic bandage. Apply the overshoe and let the patient walk. Do not try and discard the dorsal side of the cast. In the neuropathic limb bandages that are tight enough to keep a back slab firm during walking may cause exces-

sive pressure, even gangrene of the skin, around the ankle and lower leg. Also, discarding the dorsal half eliminates the Total Contact Cast effect.

NOTES

When the foot is fixed in plantar flexion and there is an ulcer over the peak of a boat shaped foot it may be difficult to get full healing by a TCC.⁴ In such cases it is best to plan a non-removable cast made with a very firm well fitted leg piece. This extends from above the malleoli to just below the tibial flare, thick enough to support a Böhler iron. The patient can walk on the iron with the body weight being carried through the shin and calf instead of the foot. It ought to be used in markedly boat shaped feet or in feet in which the talus is in danger of compression. The foot is still encased in a plaster, and does not allow trauma by bumping or direct pressure on the ulcer during walking. This means the plaster on the foot merely holds the position without allowing any weight to be borne on the ulcerated area. If it is necessary to change the dressing at regular intervals a window or a 'trapdoor' of POP or padded fibre glass can be made. Attach it with adhesive over the ulcerated area to reduce the chance of the inflamed and traumatized area from pushing through into the hole of the trapdoor. This helps to prevent further trauma to the already traumatized area. In most situations it will be better to completely seal the ulcerated area, or the inflamed area tends to mushroom through the window.

COMMENTS

Thick football or hiking socks (wool is best) are ideal. If the cast was made with little or no padding (as described) the sock provides enough padding to ensure close fit. If the patient loses weight or the cast seems loose just add another sock or two. It is easier to put on a sock without wrinkles than to put on a crepe bandage in the same thickness as previously. So a uniform 'padding' of sock is provid-

ed that can easily be increased, and it is easier to put on than a uniformly thick bandage that does not produce excessive pressures or lumps.

All patients ought to wear long socks or tubigrip that turns over at top and bottom at all times when using a total contact bivalved walking plaster cast. It is very difficult to provide, by bandaging, a uniform thickness of padding from one day to the next, or in different parts of the leg, by other means. Also it ought to be a complete long sock. Short socks or those with toes cut out (so the patient's toes can be seen), tend to wrinkle up inside the cast and this may produce other problems.

Bivalved TCCs are meant for full time wear. Patients need to have this explained. Many think "I do not need it when at home". The cast protects from minor rubs, bumps, friction and even burns. In patients in whom there is a sensory neuropathy it is essential that they learn that they must actively protect their affected limbs at all times. However, a removable TCC may, in selected cases, allow the co-operative patient the privilege of a bath, and a dressing change. The cast is removed and replaced while sitting on the edge of the bath, no steps allowed thus keeping the foot rested and protected during normal daily activity. They allow many patients to be treated at home, instead of being hospitalised. But they require very careful application, and bivalving, and a co-operative patient.

The patient ought to be able to do his own dressing and replace the TCC himself. Hence his treatment can continue at home. Also the use of a TCC after bivalving can be utilized as a learning time while the patient learns self-care (appendix C). It can be slowly discarded as the patient undergoes Trial walking before being allowed to resume unrestricted walking (appendix E). The bivalved cast is valuable for the patient's future. He should keep the cast and if the foot suffers trauma or ulceration he can use the cast again, without having to go to

clinic to get one made for him. The patient needs to understand how the bivalved TCC can help. We can help the patient to learn and we may have to 'educate' the patient many times before the patient finally understands and learns to look after himself.

REFERENCES

1. Brand PW: Insensitive Feet. The Leprosy Mission International, London, 1989
2. Coleman WC. Brand PW, Birke JA: The Total Contact Cast. A therapy for plantar ulceration on insensitive feet. *J Am Pod Med Ass*, 74:548-552, 1984
3. Novick A, Birke JA, Graham SL, Koziatek E: Effect of a walking splint and TCC on plantar forces. *J Prosth Orthot*, 3;168-178, 1990
4. Shaw ES. Wei-li His, Ulbrecht JS. Norkitis A, Becker MB, Cavanagh PR: The mechanism of plantar unloading in Total Contact Casts. Implications for design and clinical use. *Foot Ankle Int* 18:809-816, 1997
5. Warren G: The surgical conservation of the neuropathic foot. *Ann Roy Coll Surg* 71: 236-242, 1989
6. Warren G, Nade S: The Care of Neuropathic Limbs, Parthenon Publications, 1999

Appendix E

G. Warren

Trial Walking

Trial walking (TW) should be used when a patient with a neuropathic foot resumes normal walking after a long period of bed rest or a period in a walking plaster cast. This will test the integrity of the foot by showing if the healing of any pathological lesions of skin, soft tissues or bone is mature enough to withstand the stress of walking.²

METHOD

- 1) Skin care (see appendix C).
 - a. Soak the foot and remove excess callus;
 - b. Oil skin;
 - c. Put on suitable footwear, preferably lace-ups.
- 2) Supervised walking.
 - a. Supervised walking for 3 minutes on a level surface;
 - b. Rest the foot with the shoe off and splint on, (foot elevated if indicated).
 - c. Two hours after the walk check the foot for heat and swelling. Any hand will do, preferably the patients' hand.¹ (chapter 13)
 - d. If the foot shows no heat or swelling repeat the above after 2 hours. Continue to walk each 2 hours i.e. up to 4 or 5 times daily as long as no symptoms occur.

The duration of the TW can be increased daily to 5, 10, 15, 20 minutes. Continue each day increasing the duration of walk till the foot

tolerates 30-40 minutes each session, without heat and swelling. Particularly notice if there is heat or swelling first thing in the morning as this would indicate that swelling has persisted all night and hence is probably of concern and not just 'travel oedema'.

Increasing walking sessions and/or increasing walking time are the 2 common factors to develop a graded walking exercises program for a foot that has been non- or partial weight-bearing for a prolonged time.

If bathroom scales are available then this could also be used to develop an individual graded walking program for the patient. The patient could be taught to 'load' the foot by say 20 kg, and walk for a certain length of time, or distance. The 'loading' of the limb can then be increased over a period of several days/weeks until the patient is full weightbearing. This may not always be 'practical' for leprosy patients in remote areas but could be practised with patients in special settings.

If there is a hot spot, then suspend all walking till the temperature and swelling has normalised. In some patients there is a very low degree of heat and it may be the swelling that indicates a problem. When heat and swelling persists it is advisable to rest and then start again with a shorter time of walking and proceed at a slower rate.

If the heat or swelling persists, or keeps recurring there is probably still active tissue pathology and complete immobilisation should be provided for 6-12 weeks before trial walking is again instituted.

A recommended schedule for trial walking is:

Day	1-2	3-5 minute walks.	
Day	3-6	Walk 5, 7, 10	minutes.
Day	7-9	Walk 7,10,15	minutes.
Day	10-13	Walk 10, 15, 20	minutes.
Day	14-16	Walk 15, 20, 25, 30.	Add steps.
Day	17-20	Walk 20, 25, 30.	Add steps or rough paths.
Day	21	Walk 25, 30 & 40	

A schedule could be handed to the patient on discharge on which the therapist marks the recommended duration for each session of walking.

A period of trial walking is mandatory for patients that have been immobilised for a prolonged period for neuropathic bone disintegration.

In addition trial walking could be used for:

- a) Patients resuming walking after prolonged inactivity following plantar ulceration. TW minimises the possibility of stress fractures in the osteoporotic bone and it allows the patient to monitor the ulcer scar to test if it is strong enough for use.
- b) Patient presenting with a hot swollen foot in the absence of other clinical signs. The swelling should subside within a few days if the patient rests. Trial walking is the guide to normal use. If swelling/heat returns the leg should be put back in a TCC for 6-8 weeks even if a firm diagnosis can not be made. There are patients in whom

a mildly swollen foot that was present for years suddenly disintegrated. Obviously a slowly progressing bone disintegration at last reached the stage when it could no longer withstand the stress. A stress fracture may present as heat and swelling but there is no visible sign on a radiograph for 6-12 weeks. If a TCC is used early in a stress fracture it would often prevent deformity.

CONCLUSION

Trial walking is a simple way of testing the integrity of the foot and its ability to function without increasing trauma. Because of the lack of pain sensation it may be difficult to get the patients to co-operate unless they are under daily supervision as in a hospital. However, many patients have carried out TW at home with a removable TCC.

In the absence of pain, heat and swelling are the only signs that warn the patient that trauma has occurred to the foot and that something needs be done to assist the body to achieve healing. Trial walking allows the patient and clinician to test the limb's reaction to stress, act on swelling and heat and prevent neuropathic bone lesions.

REFERENCES

1. Hoeksma AF, Faber WR: Assessment of skin temperature by palpation in leprosy patients: interobserver reliability and correlation with infrared thermometry. *Int J Lepr* 68:65-67, 2000
2. Warren G, Nade S: *The care of Neuropathic Limbs- a practical manual*. Parthenon, New York, London, 1999

Appendix F

Green Pastures Hospital & Rehabilitation Centre

EYE SURGERY ASSESSMENT

(Pre- postoperative and Review)

Date: _____

Card No: _____

Age: _____ / YOB _____

Impairment grade:

RIGHT Eye

Discharge Date: _____ Review _____ Review _____

Normal

Blink:

Corneal Sensation:	yes/no	yes/no	yes/no	yes/no
Lidgap (tight eye closure)	____mm	____mm	____mm	____mm
Ectropion	yes/no	yes/no	yes/no	yes/no
Entropion	yes/no	yes/no	yes/no	yes/no
Tearing	yes/no	yes/no	yes/no	yes/no

Operation: _____

Date: _____ Surgeon: _____

Comments: (ocular pathology, adhesions, regular use of TT, etc.)

LEFT Eye

Discharge Date: _____ Review _____ Review _____

Normal

Blink:

Corneal Sensation:	yes/no	yes/no	yes/no	yes/no
Lidgap (tight eye closure)	____mm	____mm	____mm	____mm
Ectropion	yes/no	yes/no	yes/no	yes/no
Entropion	yes/no	yes/no	yes/no	yes/no
Tearing	yes/no	yes/no	yes/no	yes/no

Operation: _____

Date: _____ Surgeon: _____

Comments: (ocular pathology, adhesions, regular use of TT, etc.)

Appendix G1

Green Pastures Hospital & Rehabilitation Centre

HAND SURGERY TENDON TRANSFER

(Pre- postoperative and Review)

Right – Left (circle)

Date: _____

Name : _____

Card no: _____

Gender : ____ Age: ____ (at time of surgery)

Imp.

ANGLES: Reverse side

MUSCLE TESTING:

Ulnar	Median	
Abd. Little finger ___	Abd. Thumb ___	Duration of paralysis: _____
Abd. Index ___	Opp. Thumb ___	
Intrinsic position ___ ___ ___ ___	_____	
FDP-R/S ___ ___	FDP-I/M ___ ___	Radial
FCU ___	FPL ___	ECRL/B ___
	Pr.T ___	EDC ___
	PL ___	EPL ___
	FDS ___ ___ ___ ___	EIP/EDM ___ ___

DEFECTS (checklist) (Key: 1=thumb; 2= index finger etc.)

	Pre Therapy	Pre-Op. Date:	Discharge Date:	Review	Review	Review
Flexor tightness						
Mallet deformity						
Boutonniere						
Absorbtion						
Check rein	XX	XX				

376 Surgical Reconstruction & Rehabilitation in Leprosy

Functional Assessment

	Pre Therapy	Pre-Op Date:	Discharge Date:	Review	Review	Review
Grip strength						
Key pinch						
Grip contact						
Moberg test						
9 hole peg board						
SALSA						
Opposition						

Subjective: Preoperative

- What is of concern to the patient? Appearance – function – both (circle)
- List specific functions/tasks that the patient finds difficult or impossible to do:

Hand surgery 1: _____ Date: _____ Surgeon: _____

Hand surgery 2: _____ Date: _____ Surgeon: _____

Previous surgery:

Review: Is the patient pleased with the result?: very happy - happy - no change - worse

VMT Postop change?: _____

Comments:

Appendix G2

Green Pastures Hospital & Rehabilitation Centre

HAND SURGERY : ANGLES

	Date: / /	Pre PT	Pre OP	Wk-1	Wk-2	Wk-3	Wk-4	Rev-1	Rev-2
Index									
100									
90									
80									
70									
60									
50									
40									
30									
20									
10									
0									

	Date: / /	Pre PT	Pre OP	Wk-1	Wk-2	Wk-3	Wk-4	Rev-1	Rev-2
Ring									
100									
90									
80									
70									
60									
50									
40									
30									
20									
10									
0									

Web angle

Thumb IP
MCP

Appendix H

Green Pastures Hospital & Rehabilitation Centre

TT FOOT SURGERY ASSESSMENT

(Pre- postoperative and Review)

Date: _____

Card No: _____

Right / Left (circle)

Age: _____ / YOB _____

Impairment grade:

MUSCLE grading

TA _____

PL/B _____

TP _____

EDL _____

Comments:

EH _____

ANGLES:

	Pre	Wk 1	Wk 2	Wk 3	Wk 4	Review:				
Date										
Pass. dorsiflexion KE		XX	XX	XX						
Pass. dorsiflexion KF		XX	XX	XX						
Active plantar flexion		XX	XX	XX						
Active dorsiflexion										
Rest position										
Active range										

(Active range=restposition minus active dorsiflexion)

Pre-surgery comments:

Surgery:

Date: _____ Surgeon: _____ Tendon(s) transferred _____

Cast removal date: _____

route: circumtibial - interosseus

Insertion: TA – EDL – EH – PT (circle)

Other:

Estimated angle of immobilisation: _____ degrees

Postsurgery comments:

Gait (discharge/review):

Appendix I

Client Name: _____ Date of Casting _____

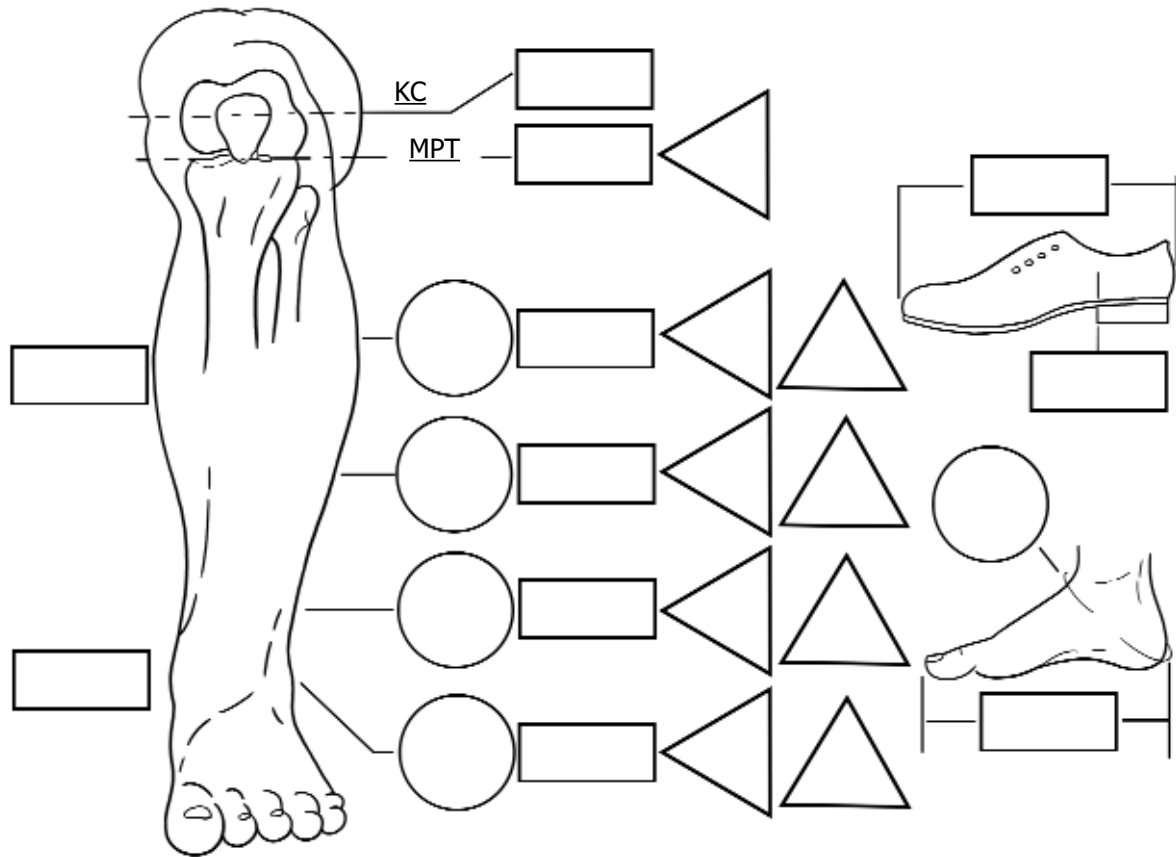
File No: _____ Date of Fitting _____

Male/Female: _____ Left/Right _____ Date of Delivering _____

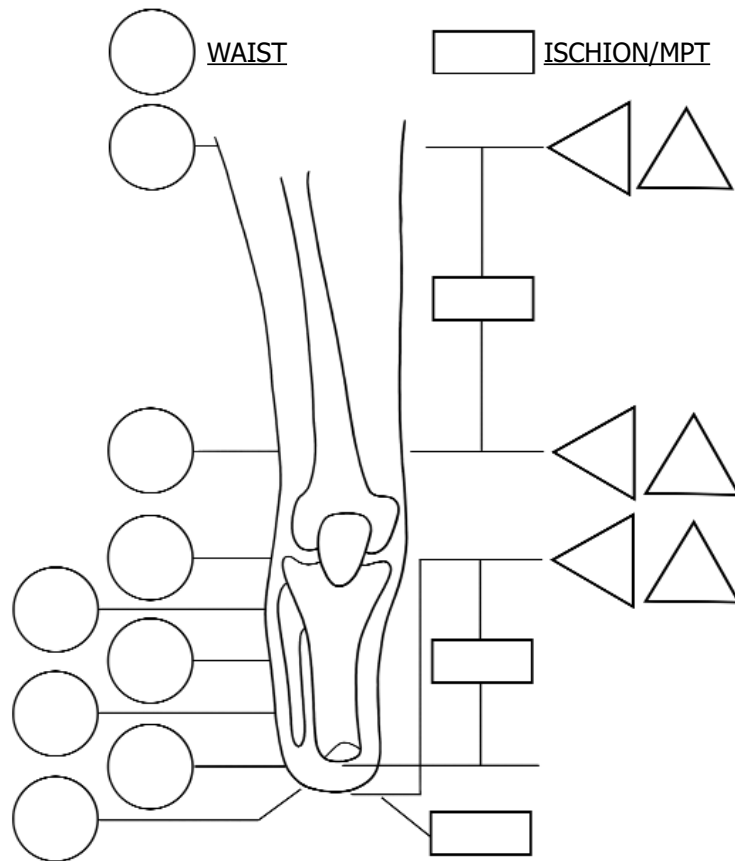
Name Prosthetist _____

Remarks _____

STUMP MEASUREMENTS



380 Surgical Reconstruction & Rehabilitation in Leprosy



	Old prosthesis	Mold: Initial Measurements	Mold: Final Measurements
0			
2.5			
5.0			
7.5			
10			
12.5			
15.0			
20.0			
AP			
ML			
MLSC			