Total Contact Cast:
Is it Really the Gold Standard?

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Original Supporting Evidence

A review of 13 published studies of total contact casting of 526 ulcers found that the ulcers had been present for 182 ± 14 days (mean ± SE), but ~88% healed in an average of 43 ± 2 days. 11 of the 13 studies had mean healing times of 36–44 days.

Total Contact Cast

Still considered by many to be the gold standard for offloading because of improved healing rates (88.9%) and cost savings when compared to standard methods of care.

Results of 9 TCC Studies

- Average Healing Time: 43.73 days
- Percent Healed: 88.9%

Helm 1984; Sinacore 1987; Walker 1987; Mueller 1989; Meyerson 1992; Birke 1992; Lavery 1997; Armstrong 2001; Birke 2002

Slide Courtesy of Greg Bohn, MD
Spencer SA. Pressure relieving interventions for preventing and treating diabetic foot ulcers. Cochrane Database of Systematic Reviews 2000

There is limited evidence of the effectiveness of orthotic interventions over removal of callus. There is some evidence evaluating the relative effectiveness of two types of orthotic devices. There is very limited evidence of the effectiveness of therapeutic shoes. Treatment There is very limited evidence of the effectiveness of total contact casts in the treatment of diabetic foot ulcers.


The total contact cast (TCC) heals ~90% of neuropathic foot ulcers by 12 weeks (average healing time of 6 weeks).

Results of 9 TCC Studies

Average Healing Time: 43.73 days
Percent Healed: 88.9%
Helm 1984; Sinacore 1987; Walker 1987; Mueller 1989; Meyerson 1992; Birke 1992; Lavery 1997; Armstrong 2001; Birke 2002
Comparison of Diabetic Wound Treatments

- **Total Contact Cast**
  - Days to Healing: 64
  - Percent Healed: 58.9%

- **Apligraf**
  - Days to Healing: 44
  - Percent Healed: 50.0%

- **Dermagraft**
  - Days to Healing: 36
  - Percent Healed: 88.9%

- **Regranex**
  - Days to Healing: 20
  - Percent Healed: 30.0%

**Use of Pressure Offloading Devices in Diabetic Foot Ulcers**

Do we practice what we preach?

- Of the 895 respondents who treat diabetic foot ulcers, shoe modifications (41.2%, \( P < 0.03 \)) were the most common form of offloading.
- 15.2% of the centers reported use of removable cast walkers.
- Total contact casts were used by only 1.7% of the centers.

- 58.1% (520 centers) did not consider TCCs as the gold standard to offload the noninfected plantar diabetic foot.
- 45.5% of the centers nationwide reported no use of TCCs.

**Slide Courtesy of Dr. Greg Bohn**

TCC: Average Observational Studies by Helm 1984; Meyerson 1992; Walker 1987; Birke 1992; Sinacore 1987; Lavery 1997; Armstrong 2001; Mueller 1989; Birke 2002


Regranex - Kantor, Margolis: Expected Healing Rates for Chronic Wounds, Wounds 2000, 12:155-158
Use of Pressure Offloading Devices in Diabetic Foot Ulcers
Do we practice what we preach?

- Reasons for Not using TCC’s
  - patient tolerance (55.3%)
  - time needed to apply the cast (54.3%)
  - cost of materials (31.6%)
  - reimbursement issues (27.5%)
  - familiarity with method of application (25%)
  - customizing parts (20.9%)
  - staffing/ordering supplies (15.2%)
  - clinician coverage (10.6%).

Off-loading the diabetic foot wound: A randomized clinical trial.
Armstrong DG, Nguyen HC, Lavery LA, van Schie CH, Boulton AJ, Harkless LB.

- Compared the effectiveness of total-contact casts (TCC), removable cast walkers (RCW), and half-shoes to heal neuropathic foot ulcerations in individuals with diabetes
- The proportions of healing for patients treated with TCC, RCW, and half-shoe were 89.5, 65.0, and 58.3%, respectively
- TCC seems to heal a higher proportion of wounds in a shorter amount of time than two other widely used off-loading modalities, the RCW and the half-shoe.

Outcome and recurrence rate of diabetic foot ulcers treated by a total contact cast

- Examined healing and final outcome after TCC
- 22-month period, 15 consecutive patients with a total of 17 ulcers started treatment with a TCC. Three ulcers were lost to follow-up (FU). Average FU was 91 weeks.
- TCC proved to be a very effective tool for healing neuropathic foot ulcers, but the recurrence rate and frequency of other complications remained very high. (8 out of 12)
- Difficult to achieve reliable (secondary) preventive general foot care, and to prescribe and manufacture reliable footwear.
98 consecutive patients casted and followed until healing; all had polyneuropathy, 44% had PAD, and 29% had infection (PEDIS grade2)
90% of all nonischemic ulcers without infection and 87% with infection healed in the cast (NS).
New ulcers, all superficial, developed in 9% and preulcerative lesions in 28% of the patients while in the cast. All complication wounds healed within 13 days.
In patients with PAD but without critical limb ischemia, 69% of the ulcers without infection and 36% with infection healed ($P < 0.01$).

Diabetic Peripheral Polyneuropathy

The absence of two of five sensory modalities:
- Vibration sensation using the 128-Hz tuning fork
- Light touch
- Sharp-Dull discrimination
- Achilles tendon reflex
- Semmes Weinstein 10-g monofilament >2 sites tested

Schaper NC. Diabetic foot ulcer classification system for research purposes: a progress report on criteria for including patients in research studies. Diabetes Metab Res Rev 20 (Suppl. 1):S90–S95, 2004

Critical Limb Ischemia

- Ankle pressure <50 mmHg
- Toe pressure <30 mmHg
- TcPo2 < 30 mmHg)

Moderate PAD
- absence of both pedal pulses
- and/or presence of intermittent claudication
- and/or ankle brachial index <0.9
- and/or toe brachial index <0.6
- and/or TcPo2 30–60 mmHg
Three total contact casting modalities were used: a nonremovable TCC, a removable TCC (RCC), and a shoe-model cast (SMC) that could not be removed by the patient. These casts were applied using a modification of the technique described by Kominsky (13), and the choice of cast was based on both patient and cast characteristics.

### Cast Criteria

<table>
<thead>
<tr>
<th>Cast</th>
<th>TCC</th>
<th>RCC</th>
<th>SMC</th>
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<tbody>
<tr>
<td>Patient</td>
<td></td>
<td></td>
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<tr>
<td>Weight (kg)</td>
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<tr>
<td>Exercise tolerance</td>
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<td>good</td>
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<td>Walking pattern</td>
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<tr>
<td>Sensation</td>
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<td>normal</td>
<td>normal</td>
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<tr>
<td>Screening adherence</td>
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<tr>
<td>Compliance</td>
<td>-</td>
<td>poor</td>
<td>-</td>
</tr>
<tr>
<td>Foot characteristics</td>
<td>-</td>
<td>hypertrophi ed</td>
<td>-</td>
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<tr>
<td>Ulcers at margin feet</td>
<td>-</td>
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</tr>
</tbody>
</table>

### Results

- pnp, presence of peripheral neuropathy, no signs of infection of PAD
- inf, presence of infection, no signs of PAD
- pad, presence of PAD, no signs of infection
- inf + pad, presence of both infection and PAD
Fife CE, et al; “Why is it so hard to do the right thing in wound care” Wound Rep Reg : 18 p 154-158 2010

- 6% DFU patients had “Gold Standard” TCC used
- Cost of care was half that of those that did not
- TCC is time consuming and poorly reimbursed
- Bilaminate skin reimbursed more generously
- 17% VLU patients received adequate compression
- Inadequate reimbursement
- Lack of familiarity with Clinical practice Guidelines

TCC - Average Outcomes of Studies by Helm 1984; Meyerson 1992; Walker 1985; Haber 1994; Beauregard 1997; Lavery 1997; Armstrong 2001; Mader 1989; Patel 2001


Regranex - Kantor, Margolis; Expected Healing Rates for Chronic Wounds, Wounds 2000, 12:155-158

TCC Systems
This experiment suggests that the name “total contact cast” is somewhat of a misnomer. To optimize wound off-loading, the cast should provide total contact everywhere except for the wound site, which should be mechanically isolated.

The conventional TCC reduced peak pressures to 98 ± 30 kPa. The wound-isolation TCC reduced peak pressures to 60 ± 16 kPa. Paired tests found a reduction in pressure by 39% ($P = 0.008$) and pressure-time integral by 25% ($P = 0.012$) compared with the conventional TCC.


Sagittal plane motion was restricted significantly more with a fiberglass cast ($8^\circ$) compared to the FP Foam Walker ($16^\circ$), and XP Pneumatic Walker ($15^\circ$), Donjoy Max Walker ($19^\circ$), and the SP Walker ($39^\circ$).

Non-Removable Cast Walker
Cable Tie System
Comparison of forefoot ulcer healing using alternative off-loading methods in patients with diabetes mellitus.


- 120 patients with DM with new forefoot ulceration at the Louisiana State University Health Sciences Center Diabetes Foot Program
- After adding ulcer grade (1, 2, or 3) and width into the model, there was no difference between healing time comparing ACCOMMODATIVE DRESSING (P =.253), HEALING SHOE (P =.815), and WALKING SPLINT (P =.525) to the TCC. Forefoot ulcers were closed within 12 weeks in at least 81% of cases irrespective of the off-loading method.
- The healing rate of forefoot ulcerations in patients with diabetes using alternative off-loading methods or a TCC appeared to be comparable when the method was selected based on location of ulcer, patient age, and duration of ulceration.

Foot pressures during gait: a comparison of techniques for reducing pressure points.

Lawless MW, Reveal GT, Laughlin RT., Foot Ankle Int. 2001 Jul;22(7):594-7

- 10 healthy, normal volunteer subjects were examined to determine the effectiveness of four modalities (fracture walker, fracture walker with insert, and open and closed toe total contact casts) in reducing plantar foot pressure
- All four treatment modalities significantly reduced (p < 0.05) plantar pressure at the first metatarsal head
- None of the methods proved to be superior
Pneumatic bracing and total contact casting have equivocal effects on plantar pressure relief.

- Compared plantar pressures produced in healthy subjects wearing a Running Shoe (RS), Total Contact Cast (TCC) and 'customized' prefabricated Pneumatic Walking Brace (PWB) [Aircast™]
- Unloading of the forefoot was 63.72% for the TCC and 58.77% for the PWB, respectively

Comparison of Offloading Treatments

Prefabricated Aircast™ Pneumatic Walker vs Standardized Shoe and TCC
Removable Cast Walker vs. TCC

RESEARCH DESIGN AND METHODS—50 patients randomly assigned to two groups: an RCW or a RCW wrapped with a cohesive bandage (Instant Total Contact Cast or iTCC)

RESULTS—An intent-to-treat analysis showed that a higher proportion of patients had ulcers that were healed at 12 weeks in the iTCC group than in the RCW group (82.6 vs. 51.9%, P = 0.02). Of the patients with ulcers that healed, those treated with an iTCC healed significantly sooner (18.7 vs. 15.2 days, P = 0.02).

Activity Patterns of Patients With Diabetic Foot Ulceration: Patients with active ulceration may not adhere to a standard pressure offloading regimen. Diabetes Care, Vol. 26, No. 9, September 2003

- 20 pts.
- Recorded total steps per day measured by a waist-worn computerized accelerometer vs. an RCW-mounted accelerometer
- 1,219 ± 821 steps taken per patient per day
- Only 28% of total daily activity was recorded wearing their RCW
- Only 30% of the patients recorded more steps on than off
- However those patients only wore the device a total of 60% of the total steps they took

RESEARCH DESIGN AND METHODS--In a prospective, randomized, controlled trial, 41 consecutive diabetic patients with neuropathic plantar foot ulcers were randomly assigned to one of two groups: an irremovable RCW (iTCC) or a standard TCC. Primary outcome measures: ulcers healed at less than or equal to 12 weeks, healing rates, complication rates, cast placement/removal times, and costs.

RESULTS--Proportions of patients healed within 12 weeks in the iTCC and TCC groups were 94 and 93%, respectively, when patients who were lost to follow-up were excluded. Healing rates were statistically equivalent in the two groups, as were complication rates.

The iTCC took significantly less time to place and remove than the TCC. Also an overall lower cost associated with the use of the iTCC compared with the TCC.

An Off-the-Shelf Instant Contact Casting Device for the Management of Diabetic Foot Ulcers: A randomized prospective trial versus traditional fiberglass cast Diabetes Care March 2007 vol. 30 no. 3 586-590 Piaggesi A. et al.

No statistical difference observed in healing rates between groups A (TCC) and B (DM Walker), (95 vs. 85%), healing time (6.5 ± 4.4 vs. 6.7 ± 3.4 weeks), and adverse events (6 vs 4) n=40

- Group B, was 78% less expensive compared with group A (P < 0.001)
- Time required for application reduced by 77% and removal 58% compared to group A (P < 0.001)
- Patients’ satisfaction with the treatment was higher in group B (P < 0.01)


45 diabetic patients with nonischemic, noninfected neuropathic plantar ulcers were randomly assigned for treatment with a total contact cast [TCC] group or walker cast (Stabil-D group).

- Ulcer surface decreased from 1.41 to 0.21 cm² (P < 0.001) in the TCC group and from 2.18 to 0.45 cm² (P < 0.001) in the Stabil-D group (P = 0.722).
- 73.9% in the TCC group and 72.7% in the Stabil-D group achieved healing (P = 0.794).
- Average healing time was 35.3 ± 3.1 and 39.7 ± 4.2 days in the TCC and Stabil-D group, respectively (P = 0.708).
Stabil-D Orthosis

Total Contact Cast Indications
- Plantar ulceration Wagner grade I and II, UTHSC grade A0, 1, 2, or 3
- Neuropathic, pressure, traumatic
  - Avoid: Arterial, Venous
- Neuropathic fracture (Charcot)
- Post-reconstructive surgery


Total Contact Cast Contraindications
- Acute infection
- Fever
- Palpable lymph nodes
- Deep sinus tract or narrow deep wound
- Perfuse drainage
- Active dermatitis
- Excessive/Fluctuating edema
- Claustrophobia
- Known non-compliance
- Arterial insufficiency
  - ABI <0.8
- Wagner Grade III, IV, V
- None of these are absolute contraindications to the use of a removable cast walker
Total Contact Cast
Stockinette, Foam, Light Dressing

Total Contact Cast
Felt Protectors

Total Contact Cast
Gypsona Plaster Base
Total Contact Cast
Fiberglass Reinforcement

Wound Isolation TCC
M Petke, P Tokar, D Kostar, PR Cavanagh
Diabetes Care 28:929-930, 2005

Skive the Foam to Create a Cavity That is More Boat-like than Cylindrical

TCC Systems
Football Dressing for Neuropathic Forefoot Ulcerations

- 15 Subjects
- Total weeks to complete epithelialization 3.8 ± 2.60 (range 1-10 weeks)
- Inexpensive, easy to apply
- Non-adherent contact layer covered by a silver alginate and a foam secondary dressing
- 3 rolls 4” cast padding, 1 roll 4” gauze, 1 roll 4” self adherent wrap
- Standard post op or cast shoe for ambulation


- Forty-one consecutive subjects with 58 wounds were enrolled.
- Overall wound healing rates for University of Texas Health Science Center class 1A, 1B, 1C, 1D, 2A, 2B, 2C and 3B plantar forefoot ulcerations is 2.91 weeks with a 95% confidence interval of 2.36–3.47 weeks for complete wound epithelialization.
Football Dressing for Neuropathic
Forefoot Ulcerations