


**Does Friction/Shear Reducing  
Low Friction Fabric  
in Total Contact Cast (TCC)  
and Charcot Restraint  
Orthotic Walker (CROW)  
Enhance Wound Healing  
and Safety?**

By: Jan Chevrette  
FNP-C, CWOCN, CFCN and  
Ulrich Schmidt, CPO

Regions Hospital Wound Clinic  
St. Paul, MN and  
Winkley Orthotics & Prosthetics  
Minneapolis, MN



## PURPOSE

In diabetic foot ulcer therapy, both the Total Contact Cast (TCC) and the Charcot Restraint Orthotic Walker (CROW) are considered the Gold Standard and are designed with two intentions:

- To reduce (redistribute) pressure on the load-bearing surface.
- To reduce friction and shear forces potentially interfering with wound healing. TCC and CROW orthoses achieve this goal to a much higher degree than standard footwear or even custom-made shoes. There are limiting factors, however:
  - Some friction and shear - as indicated by disturbed wound dressings - remains in the contact area; therefore, we must assume that it affects wound healing.
  - The clinical effect of friction is at the cellular level and results in callus formation, tissue deformation (strain), ulceration and impeded wound healing.

The purpose of this case study is to observe and report the mechanical benefit of introducing a low friction interface fabric over the dressings in diabetic foot care.

## METHODS

Prior to beginning a complex and expansive study format, a smaller observational review of a total of 12 subjects was conducted so that the author could develop both confidence in the low friction intervention (fabric) and an understanding of its optimal application. Chosen individuals were educated about and agreed to use the (FDA registered) low friction intervention, which was designed either as a loose textile patch or a textile patch stitched to a sock. The author followed the results in weekly reviews and observed an increase in longevity of undisturbed wound dressing, as well as facilitated wound healing. Photographic images and objective measurements were documented.

## RESULTS

- The low friction interventions:
  - eliminated disturbance of wound dressings, increased wear time
  - facilitated the healing process as evidenced by continued/complete wound healing without recurrence during the study period
- All volunteers showed satisfactory or accelerated healing progress.
- None of the subjects developed any complications, and there were no side effects.

## CONCLUSIONS

- Low Friction Fabric interventions as applied, demonstrated friction and shear reduction between the dressings, paddings and shells of TCC and the CROW.
- Integrity of wound dressings remained intact between weekly reviews.
- Dressing longevity improved, reducing frequency of visits.
- This case series, showing a variety of examples of our use of Low Friction Fabric interfaces in the TCC and the CROW, is not to be understood as a scientific study.
- “Before and after” measurements and photographic outcome documentation, as well as clinical observation and comparison to author’s experience, provided new insight.
- The case study served as a pilot and provided the author with confidence to move forward with a more expansive study in the future.
- Friction and shear cannot be reliably measured to date, but the clinical observations above allowed us to conclude that less friction and shear were transferred to the dressing and the underlying wound.

## INTRODUCTION – “LOW FRICTION FABRIC”

A patch of ultra low friction fabric, permeable for air, moisture and heat, was strategically applied between the primary wound dressing and the hard shell of TCCs and CROW walkers.

Significant reduction of friction and shear, which often occur during the treatment of diabetic feet, was a reasonable clinical expectation. For better understanding of the “Low Friction Fabric” used in this case studies, see Fig. 1 and fabric sample.



Fig. 1: Low Friction Fabric

## CASE STUDY #1

### HISTORY:

- 47-year-old male with type 2 diabetes since 2008
- On disability due to back pain
- Right TMA 2015 discontinued ulcer with underlying osteomyelitis
- Right plantar 1st & 5th & lateral 5th metatarsal ulcers since Aug. 2016
- Referred to wound clinic in mid Jan 2017 for total contact casting
- Lateral metatarsal dressing dislodged in TCC



Fig. 1: February of 2017, weekly review: Lateral-distal dressing dislodged inside the TCC due to remaining shear forces.

Shear forces of a magnitude sufficient to destroy wound dressing are considered to have an unwanted effect on the underlying wound tissue.



Fig. 2: The Low Friction Fabric patch covers the primary wound dressing. It is placed in the anterior and anterior-distal aspects of the TM-amputation site. Thus it provides a strategic low friction interface, targeted to protect amputation-related subcutaneous bony prominences.



Fig. 3: Here the Low Friction Fabric patch covers the primary wound dressing. It is placed in the plantar aspect of the residual foot.

Thus it provides a strategic low friction interface, targeted to protect existing plantar ulceration.

### Findings of recent treatment:

- Dressing stayed undisturbed in place once Low Friction Fabric was applied.
- Wound rapidly improved and healed within 1 month.
- Low Friction Fabric sock to be included in accommodative footwear when TCC is discontinued.
- No unwanted side effects.
- Patient to remain in maintenance TCC (with Low Friction Fabric application) until protective footwear is fit and delivered.

## CASE STUDY #2

### HISTORY:

- 52 year old female with poorly controlled type 2 diabetes since 2000
- Recent HgbA1c 12.8, smoker since age 11
- Left 5th toe & ray amputation 2011 due to osteomyelitis
- Chronic left plantar 4th met head wound since 2015
- Partial right amputation of toes 2 through 5 in 2012 due to osteomyelitis
- Right partial hallux amputation
- Incision separation chronically open since 2014
- Patient referred to wound clinic in Nov. 2016
- 2016 began right TCC with little wound improvement
- Dressing dislodgement in TCC

### Recent treatment:

- Low Friction Fabric patch was placed over dressing.
- Left plantar 4th met head wound treated with antimicrobial absorbent dressing & accommodative footwear with minimal improvement until TCC began in Jan 2017.
- With Low Friction Fabric application, the dressing stayed in place & wound healing improved rapidly. Wound healed within 2 months.
- Patient now in a CROW and wears a Low Friction Fabric forefoot sock applied as maintenance friction/shear reduction strategy.
- Again, dressing dislodgement in TCC until Low Friction Fabric was applied.



**Fig. 1:** Tissue condition as of December of 2016 (see text)



**Fig. 2:** Condition December 2016  
Low Friction Fabric patch placed on top of primary wound dressing. Attached with 2 small self-adhesive tape tabs. Further layers of padding and TCC casting still to be applied.



**Fig. 3:** Different view of December 2016  
Placement of Low Friction Fabric Patch over primary dressing.

**Fig. 4:** Low Friction Fabric Forefoot Sock  
The low friction segment is designed in a cap-like covering over all of the forefoot, including the toes and entire metatarsal heads.



### Findings of recent treatment:

- Dressing stays undisturbed in place (once Low Friction Fabric was applied).
- Wound healing rapidly improved, wound healed within 1 month.
- Patient now in CROW orthosis with Low Friction Fabric forefoot sock.
- Wounds remain healed with no return of callus.
- No unwanted side effects.

## CASE STUDY #3

### HISTORY:

- 50 year old male, type 2 diabetes since 2013 (most likely present much longer), developed Charcot foot deformity mid-summer 2015, no insurance so did not seek medical care
- Developed mid-foot plantar ulcer in Dec 2015; using off-the-shelf footwear
- Referred to our wound clinic, treated with a total contact cast for 12 weeks
- Dressing dislodged therefore Low Friction Fabric was added
- With Low Friction Fabric application, dressing remained in place & intact
- After 12 weeks he was transitioned to new insert/accommodative footwear
- After 1 week in shoe, the ulcer enlarged with traumatized appearance
- Resumed TCC for 7 weeks with Low Friction Fabric over the dressing
- Transitioned back to custom insert/shoe in April 2016 with compression sock for edema management, but without Low Friction Fabric application
- Wound improvement was negligible without Low Friction Fabric in place

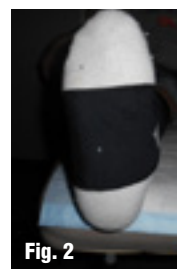
### Findings of recent treatment:

- Low Friction Fabric patch applications started again in Oct 2016 (Fig. 2 and 3)
- Wound healing started to improve immediately
- Patient was fit with Low Friction Fabric midfoot sock in Nov 2016
- Wound continued to improve rapidly & is almost healed (January 2017)



**Fig. 1**

**Fig. 1**



**Fig. 2**



**Fig. 3**

## CASE #4 ALTERNATIVE APPLICATION EXAMPLES



**Fig. 3**

**Fig 1:** Plantar surface of TMA with Low Friction Fabric patch added to AFO sock for use in CROW.



**Fig. 2**

**Fig 2:** Medial malleolus patch application on external surface of AFO sock for use in CROW.



**Fig 3:** Application of Low Friction Fabric in form of (custom-made) TMA sock. The complete foot component of a standard AFO sock was replaced with a custom sock with strategically placed Low Friction Fabric on the plantar aspect of the foot & on the medial malleolus area.

A sock has the advantage of allowing daily application by the patient once they have transitioned to a CROW.

### Similar findings of Case #1 through Case #4:

- Low Friction Fabric has shown very similar results of friction and shear reduction in the TCC and in the CROW.
- Wound healing seems to be facilitated and/or accelerated in both interventions.
- Based on the encouraging clinical results, trials in larger studies are indicated.

# REFERENCES

## Publication References

- 1 International Review: Pressure Ulcer Prevention; pressure, shear, friction, and microclimate in context – A consensus document – Wounds International 2010.
- 2 Stekelenburg A, Strijkers GJ, Parusel H, Bader DL, Nicolay K, Oomens CW. Role of ischemia and deformation in the onset of compression-induced deep tissue injury: MRI-based studies in a rat model. J Appl Physiol. 2007 May;102(5):2002-11.
- 3 Bennett L, et al. Shear vs pressure as causative factors in skin blood flow occlusion, Arch Phys Med Rehabil. 1979; 60:309-314.
- 4 Ceelen KK, Stekelenburg A, Loerakker S, Strijkers GJ, Bader DL, Nicolay K, Baaijens FP, Oomens CW. Compression-induced damage and internal tissue strains are related. J Biomech. 2008 Dec 5;41(16):3399-404.
- 5 Cottenden AM, Wong WK, DJ Cottenden DJ, and Farbrot A. "Development and validation of a new method for measuring friction between skin and nonwoven materials". Proc Inst Mech Eng [H] 2008;222(5):791-803.

## Case Report References

- 6 "Able to heal a wound that didn't heal in 15 months prior"; Sara Stover RN DON, Villa Manor Care Center
- 7 "Using Strategic Friction Reduction to Prevent and Treat Pressure Injuries"; Sheila Howes Trammel MSN, APRN, FNP-BC, CWCN, CCCN, CFCN, CLCN, Hennepin County Medical Center, Minneapolis MN
- 8 "Wound Healing Improvement with Low Friction Seat and Back Rest Cover in Wheelchair"; Jan Chevrette, MSN, FNP-C, RN, Regions Hospital St. Paul MN
- 9 "Friction Wound Healing Improvement at W/C Alignment Support Pad with Textile Low Friction Interface"; Julie Roskamp, RN, CWCON, Twin Cities Wound and Ostomy Associates Inc., Lakeville, MN
- 10 "Wound Healing Support in a Quadriplegic Individual using bilateral Low Friction Textile Leg Sleeves"; Adam Reed Johnson, DPM, Medical Director, Center for Wound Healing, Hennepin County Medical Center
- 11 "Skin Healing in IAD in a bed-bound Individual through Application of a Textile Low Friction Interface"; Rosie Jovane, CPO, Troy MI
- 12 "Heel Decubitus Ulcer Healing support by Application of Low Friction Textile Custom Sock"; Adam Reed Johnson, DPM, Medical Director, Center for Wound Healing, Hennepin County Medical Center
- 13 "Three Cases of Transtibial Amputation Wound Healing under Weight Bearing Conditions (Prosthetic Use) in a Prosthetic Socket"; Charles Kuffel, CPO and Kevin Hines CPO, ARISE Orthotics & Prosthetics, Blaine MN

# ACKNOWLEDGEMENT & CONTACT

No external funding was received for this research. The investigators retained full independence in the conduct of this research.

Low Friction Fabric interventions and custom made socks were received as free trials from Tamarack Habilitation Technologies, Inc.

Contact all authors at Tamarack Habilitation Technologies, Inc.  
1670-94th Lane NE, Minneapolis, MN 55449  
Email: [info@tamarackhti.com](mailto:info@tamarackhti.com)