Treatment of Non-Healing and/or Recurrent Wounds

Best outcomes require understanding and implementing biomechanics.

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In the 1970s, biomechanics was a major area of interest in academia and clinical practice. Everyone wanted to get on board and to understand how to implement these principles into their practice. The result was a boom in interest in the podiatric profession. The key front runner was sports medicine. It moved the podiatry profession directly into mainstream of medicine. Podiatric medicine was at the center of the educational endeavors in clinical practice.

That interest in podiatry has been lost over the past several years, as podiatry's focus upon biomechanics has been replaced by increasing interest in surgery and other more "glamorous" practices of medicine. The result of this is that physical therapists and other specialists are seeing the writing on the wall and are increasingly taking on these principles and adding them to their therapies. One of the casualties of podiatry's lessening interest in biomechanics has been in the field of wound management. As other fields of medicine absorb and implement biomechanics for recurrent or non-healing plantar wounds, podiatric medicine is at an increased risk of becoming more obsolete, less up-to-date, less complete, not as thorough, and missing an important aspect of wound care.

There is an old saying that "if you always do what you always did, you are going to get what you always got." To make a change sometimes requires a leap of faith. This is especially true when it comes to biomechanics. The reason is that the literature is scant and there is a lack of good scientifically-balanced studies that definitively conclude and show evidence of how effective biomechanical principles can be. Many of the studies are anecdotal. But one can argue that evidence-based medicine may be over-weighted and will not necessarily lead to the best form of treatment. Lack of evidence does not automatically mean that something does not work.

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There are many reasons that podiatric studies of biomechanics have not been published. Much of this is economically-driven because there is not a lot of funding involved. It's simply talking about principles without talking about products that can be sold, or advanced therapies that can create revenue. Funding resources are minimal for biomechanical studies.

There are other reasons as well, but the conclusion does not change; and as a result of a lack of good clinical studies, there is little clinical evidence of effectiveness. Thus the reader needs to take a leap of faith if one were to implement and understand these principles. That is, that *biomechanical understanding and implementation are key factors in optimizing wound care for forefoot plantar non-healing or recurrent wounds.*

The following case scenarios are presented here to support the above statement and demonstrate how an intuitive treatment regimen may not necessarily provide the best therapy for a patient facing biomechanical imbalance of the foot.

Case 1

A 35-year-old patient comes to the office with a painful plantar pre-ulcer callus under the ball of the foot. It extends primarily on the metatarsal heads two through five. The intuitive treatment might be to provide weight-bearing and friction-absorbing material under the area of chief concern.

This treatment may provide a satisfactory result for specific pa-

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tients but may not necessarily yield the best result. Alternatively, a biomechanical assessment demonstrates that the patient has hypermobility first ray. Thus, upon weight-bearing, the ray dorsiflexes, transferring vertical ground reactive forces from the first metatarsal head to the second, third, and other lesser metatarsals.

The better alternate treatment incorporates the biomechanical treatment that stabilizes the foot in such a way that the hypermobility resolves to allow the first metatarsal to maintain its normal position and not dorsiflex reactively to the vertical and shear forces of weight-bearing. The result is that the first metatarsal head maintains a position parallel to the second, third, and other lesser metatarsals so that the ball of the foot is parallel to the ground with equal weight-bearing through all five metatarsal heads.

There are many methods of treatment that mechanically stabilize the foot and the first metatarsal against hypermobility. These methods are beyond the scope of this manuscript but the end result of all of this is the same: improved first metatarsal functionality allows the first metatarsal to properly bear weight which prevents weight-bearing forces being transferred to the lesser metatarsals. This decreases the callus and plantar pressure applied to metatarsals two through four during ambulation.

Without this therapy, the first metatarsal will maintain hypermobility and dorsiflex reactive to weight-bearing, transferring the vertical, compression, and shear to the second, third, and lesser metatarsals. The skin beneath the metatarsals reacts by developing "protective" calluses and potential pain under the second through fifth metatarsal heads. This will lead to plantar ulcers without successful therapeutic intervention.

Case 2

A diabetic patient of 48 years of age presents to the office with pain under the ball of the foot—a similar complaint to that described in case 1. The intuitive rationale would be to simply apply a pad under the symptomatic area under the ball of the foot. Although the presentations in the first and second scenarios described are similar, the biomechanical etiology is much different. In the second scenario, the patient has diabetic neuropathy, which causes an imbalance in the musculature of the lower leg.

Muscular imbalance of the posterior calf musculature overpowering the anterior musculature is known as a muscular equinus of the ankle.

In short, the posterior calf muscles become tight and lose flexibility. This is induced by a muscle imbalance, producing a very tight posterior musculature to the calf, which overpowers the anterior musculature and prevents normal ankle dorsiflexion for normal gait. Normal ambulation requires that the ankle must be able to dorsiflex 10-15° just prior to heel lift in the gait cycle. This is required when one walks, as the body moves forward over the foot, which is planted firmly on the ground. If the ankle cannot dorsiflex, the heel will be forced to lift from the ground prematurely, resulting in the forefoot absorbing increased weight-bearing pressures for a much longer period of time than it would otherwise if normal dorsiflexion were able to occur at the ankle. This results in the development of plantar calluses and increased pain under the ball of the foot, and is a leading cause of ultimate ulceration.

There are many ways to address the biomechanics in this case, which describes what is known as gastrocnemius equinus. One of these treatments is a simple surgical procedure to lengthen the Achilles tendon, which will allow dorsiflexion to occur much more easily.

Conservative care to address the biomechanics would be to place a wedge under the foot, allowing the heel to remain in an elevated position when the body is standing still and the leg is perpendicular to the ground. This decreases the need for ankle dorsiflexion during the propulsive phase of the gait and allows the entire foot to remain weight-bearing during the gait cycle. This muscular imbalance of the posterior calf musculature overpowering the anterior musculature is known as a muscular equinus of the ankle. It is also referred to as "tight heel cord", referring to the Achilles tendon and its attachment from the gastrocnemius and soleus muscles.

The inability of the ankle to dorsiflex normally during gait results in premature heel lift, forcing the forefoot to absorb more weight for a longer period of time than it would if the foot dorsiflexed normally prior to heel lift.

To summarize and clarify the above scenario, the inability of the ankle to dorsiflex normally during gait results in premature heel lift, forcing the forefoot to absorb more weight for a longer period of time

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than it would if the foot dorsiflexed normally prior to heel lift. While a pad under the ball of the foot may be helpful in limiting some discomfort and the amount of callus, it does not address the biomechanical abnormality which would best be addressed with either surgical lengthening of the Achilles tendon apparatus or conservatively placing a lift under the heel.

In conclusion, the lower extremity, and especially the foot with 26 bones in each extremity, tendons, and muscles all interact to create motion. The laws of physics are very simple and describe the basic principle that for every action there is a reaction. Comprehensive and complete treatment requires understanding biomechanical principles and applying specific interventions to alter their behavior. This translates into reduction of the forces affecting the plantar foot: vertical, compression, and shear.

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There is an old saying (at least among podiatrists), "It is not just what you applied to the foot, it is what you removed from the foot that leads to improved health and function of chronic wounds." Biomechanics and the principles applied are methods to reduce, modify, or otherwise change the amount and the manner in which the three forces are applied to the foot, causing an increased risk of chronic non-healing or recurrent wounds.

The following are suggested reading for further information on the subject. Interested readers should also seek online courses, conferences, and multiple webinars available by many professional organizations.

Martinengo, L, et al., Prevalence of chronic wounds in the general population, National Institutes of Health (NIH) (.gov), 2019, https://pubmed.ncbi.nlm.nih.gov/30497932/

Diabetic Foot Ulcers, Medcape, Jan 6, 2025, https://emedicine.medscape.com/article/460282-overview. PM

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