

# A novel method of assessment of microcirculatory changes with the use of geko™ Device in patients with Venous Leg Ulcers

Saroj Das<sup>1</sup>; Luxmi Dhoonmoon<sup>2</sup>; Duncan Bain<sup>3</sup>; Swati Chhabra<sup>4</sup>



## BACKGROUND

The geko™ device, powered by On Pulse™ neuromuscular electrical stimulation technology<sup>1</sup>, has been recommended for use in the treatment of venous leg ulcers.<sup>2</sup>

Studies have shown changes in the microcirculation environment in the wound bed and peri-wound area in patients with venous ulcers. In this study, we have examined the microcirculatory flow in both the wound bed and the peri-wound area using Laser Speckle Contrast Imaging (LSCI).

LSCI is a non-invasive and non-contact technique that is used to measure the changes in microcirculatory flux in the skin or other areas where blood vessels are superficial. This has shown to accurately measure blood flow over moving skin surfaces.

## AIM

To examine the effects of geko™ on the microcirculation of the wound bed and peri-wound area in patients with venous leg ulcers.

## METHODS

This prospective study was approved by the Hospital Ethics Committee.

Sixteen patients with chronic venous leg ulcers eligible for the study according to the inclusion criteria were recruited from the complex wound clinic.

Each patient was examined in a recumbent position with the leg outstretched resting on an evacuated bean bag cushion to immobilise the leg for measurements. A reference marker, consisting of an opaque foil strip, was affixed to the skin adjacent to the wound, to allow for correction of movement artefact. The LSCI imager was positioned to record images in the wound bed, peri-wound area and the reference marker.

Measurements were made of Baseline (following a 10-minute stabilisation period with the patient at rest in recumbent position) and with the geko™ fitted and active for 10 minutes with the patient at rest in recumbent position.

## RESULTS

Figure 1 shows an example trace of microcirculatory flux in the wound bed for an individual patient. The blue trace shows the baseline (geko™ off) flux over a 15 second period. A pulse of approximately 72 beats per minute (BPM), with a mean flux of 106 arbitrary units. The pulsatility (pulse amplitude) is 12 units at baseline. When the geko™ is switched on (orange trace), there is a substantial elevation in mean flux from 106 to 224 arbitrary units. Additionally, the pulsatility increases from 12 to 102 units. As expected, the 'pulse' observed with geko™ on is at precisely 60 BPM, since this is the frequency of muscle contractions elicited by the geko™.

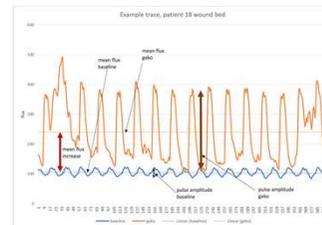


Figure 1

Figure 2. shows the mean (s.d.) values of flux for all patients, in both the wound bed and the peri-wound area. As with figure 1, baseline (geko™ off) is shown in blue, and geko™ on is shown in orange. In both the wound bed and the peri-wound area, geko™ produces a substantial and significant ( $p=0.014$ ,  $p=0.004$ ) increase in flux. It must be noted that although the error bars apparently overlap, this predominantly reflects inter-subject variations rather than intra-subject variations, so the paired data still yields significance.

Referring to Figure 3, geko™ has an even more pronounced and highly significant ( $p<0.001$ ,  $p<0.001$ ) effect on pulsatility in both the wound bed and the peri-wound area. This is of particular pertinence to wound healing, since pulsatile flow is considered to be vital. Pulsatile blood flow results in shear forces at the endothelial surface and results in chemical signalling and transduction.<sup>3</sup> This intermittent pressure and velocity in vessels result in forces at the cellular level initiating biochemical changes, including the production of growth factors, Nitric oxide production, and the reduction of oxidative stress.<sup>4</sup>

Figure 2

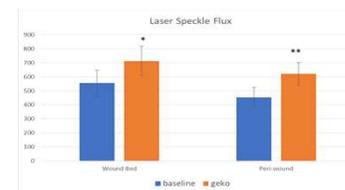
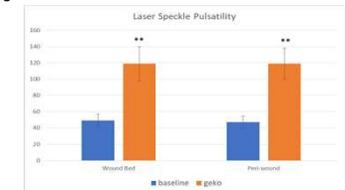


Figure 3



## CONCLUSION

In the wound bed and peri-wound area, geko™ produced a substantial and significant ( $p=0.014$ ,  $p=0.004$ ) increase in flux. geko™ had an even more pronounced and highly significant ( $p<0.001$ ,  $p<0.001$ ) effect on pulsatility (PA) in both the wound bed and peri-wound area.

Our results suggest that LSCI accurately measures the changes in microcirculatory flux in the skin, where blood vessels are superficial.

These results further confirm that the geko™ device improves the microcirculatory environment in the wound and peri-wound area and may be beneficial in wound healing.

## REFERENCES

- 1 Tucker A, Maass A, Bain D, Chen LH, Azzam M, Dawson H, et al. Augmentation of venous, arterial and microvascular blood supply in the leg by isometric neuromuscular stimulation via the peroneal nerve. *Int J angiology* 2010 Spring;19(1): e31-7.
- 2 Jawad, H., Bain, D., Dawson, H., Crawford, K., Johnston, A., Tucker, A.T. The effectiveness of a novel neuromuscular electrostimulation method versus intermittent pneumatic compression in enhancing lower limb blood flow. 2014 *Journal Vasc Surg. Vol 2, No 25*
- 3 Chen KD, Li YS, Kim M, et al. Mechanotransduction in response to shear stress. Roles of receptor tyrosine kinases, integrins, and Shc. *J Biol Chem* 1999;274:18393-18400
- 4 Ennis WJ, Lee C, Meneses P. A biochemical approach to wound healing through the use of modalities. *Clin Dermatol* 2007;25:63-72

## Contact information

1London North West University Health Care NHS Trust, London, UK; 2CENTRAL AND NORTH WEST HEALTH CARE NHS TRUST, UK; 3geko First Kind, London, UK; 4London North West University Health care NHS Trust, London, UK