IMPROVED LOWER LIMB CIRCULATION AND WOUND HEALING DUE TO CYCLOIDAL VIBRATION THERAPY (VIBRO-PULSE®): DOPPLER COMPARISON OF THE TREATED AND UN-TREATED DIABETIC LIMB.

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Introduction
Reduced circulation can exacerbate tissue ischemia and prolong wound healing (1), this in particular applies to diabetics with neuro-ischemic ulceration or wounds following surgical intervention. Many diabetics suffer with various levels of either macro or micro angiopathy. Vascular surgical intervention can improve blood flow from occlusion above the knee, however this becomes more difficult for below the knee peripheral vascular disease.

Vibro-Pulse® (Fig 1) is a medical device that applies low frequency oscillation vibration to the lower limb. The frequency range of vibration has been shown to increase skin and soft tissue blood flow (2) including in diabetics (3). Vibration results in mechanotransduction, cells convert mechanical forces in to chemical activity, in this instance stimulating the production of nitric oxide a vaso-dilator by means of eNOS synthase which controls vascular tone. (4) Vasodilation also increases cellular shear stress against the vessel wall (5), this has been shown to stimulate angiogenesis that would aid effective wound healing. In diabetics arterial intimal thickening can impede diffusion of nitric oxide from the endothelial to the smooth vascular muscle. The relationship between poor wound healing and low shear stress of endothelial cells or turbulent flow due to reduced blood flow as a result of vascular disease has been shown (6). In particular with diabetes it has been shown to effect angiogenic growth factors and inhibitors reducing angiogenesis activity (7) impairing such as collagen vessel growth. The following is a record of wound healing and change in blood flow between the treated and untreated lower limb of a diabetic self applying Vibro-Pulse at home 3 x a day for 30 minutes.

Method
The patient met the indications and contraindications for use and consented to use the product. Continuing with standard treatment a Vibro-Pulse unit was allocated to the patient to self apply at home for 3 x a day for 30 minutes to treat his right lower limb wound only.

Patient: Male. 72 years old diabetic with angiopathy in the right lower limb. The right leg non-healing transverse metatarsal surgical wound following amputation due to tissue necrosis. Wound dressing Hydroagar gel + triadine. Wound duration 6 months prior to commencing Vibro-Pulse. The patient was assessed at clinic every 2 weeks and the following recorded.

- Wound status   • Wound area   • Photograph   • Pain score. 0 no pain to 5 excruciating
- visual analogue scale. The patient also had a Doppler measurement (Dopplex Assist, Huntleigh)
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Results: Measurement / Observations

<table>
<thead>
<tr>
<th>Start</th>
<th>Week 8</th>
<th>Week 10</th>
<th>Week 12</th>
<th>Week 14</th>
<th>Week 16</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wound Size</td>
<td>0.3 cm²</td>
<td>7.5 cm²</td>
<td>22.5 cm²</td>
<td>22.5 cm²</td>
<td>18.75 cm²</td>
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<tr>
<td>Exudate</td>
<td>Clear</td>
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<td>Clear</td>
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<td>Clear</td>
</tr>
<tr>
<td>Wound bed</td>
<td>Healthy</td>
<td>100% epithelialisation</td>
<td>Healthy</td>
<td>Healthy</td>
<td>Healthy</td>
</tr>
<tr>
<td>Peri-wound</td>
<td>Healthy</td>
<td>Healthy</td>
<td>Healthy</td>
<td>Healthy</td>
<td>Healthy</td>
</tr>
<tr>
<td>Pain 0-5</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
</tbody>
</table>

Discussion
Improvement in wound healing had been slow to date with a duration of 6 months following transverse metatarsal amputation. Applying Vibro-Pulse 75% healing occurred in the first 8 weeks of the rate of healing then slowed with full healing by week 16.

The patient recorded a reduction in pain from 3 medium to 0 none by week 6. Doppler readings showed that at the start both lower limbs had diabetic macro and micro angiopathy at an advancing stage of morbidity. However at week 8 and at week 16 there was a clear improvement in blood flow in the Vibro-Pulse treated right lower limb, this compared to a further deterioration in blood flow in the untreated left lower limb.

The non-invasive application of vibration therapy results in the stimulation of endothelial nitric oxide synthase resulting in vasodilation and changes in vascular tone. As shown in the changes in blood flow noted between the left and right lower limbs.

Conclusion
Vibration therapy (Vibro-Pulse) was effective in stimulating the healing of this diabetic lower limb wound.

Improving blood flow was noted in the treated lower limb compared to the untreated lower limb. Further blood flow comparative studies on lower limb macro and micro angiopathy patients is recommended.

References