

# INFLUENCE OF CYCLOIDAL VIBRATION (VIBRO-PULSE®) ON SKIN BLOOD FLOW CHANGES OBSERVED AN IN VIVO MICRO-CIRCULATORY MODEL.

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## Introduction

Critical to the wound healing process is effective blood supply both macro and microcirculation within and around the wound. Clinical conditions such as peripheral vascular disease or excessive pressure result in poor circulation and can exacerbate tissue ischemia and prolong wound healing. (1) Studies have shown the effects of non invasive application of vibration on the circulation and blood flow within skin and soft tissues. Methods used include plethysmography (2), thermography (3) and laser doppler (4). These have shown that low levels of oscillation vibration can increase skin and soft tissue micro-circulation. As a consequence the purpose of this study was to observe and determine the effects of vibration on skin blood vessels in an in vivo micro-circulatory model.

## Method

Twenty hairless mice were used for the study (approved by the University of Brussels ethical commission 65 M/IOPS NMRI VRO 30G and 50 S/SOPF Swiss NU/NU FE 20G). A transparent probe was attached to a modified cycloidal vibration generator (Vibro-Pulse, Fig1. Vibrant Medical Ltd. UK) transmitting a frequency of 28HZ and acceleration of 1.8 m/s<sup>2</sup> oscillating action in three planes, along traverse and radially from the vibration generator. The Method used was transillumination microscopy in vivo. The mice were submitted to a total anesthesia

with Urethane 25% subdermal injection. A longitudinal incision was made along the Linea Alba of the abdominal skin and the animal was placed and supported under a Leitz OPMI microsurgery microscope. The skin from the incision was then reclined and secured over the transparent probe attached to the cycloidal vibration generator. A cold light source (Volpi Intralux 6000) then illuminated the underside of the reclined skin.

A measurement grid was placed over the microscope as a base line to take an estimated quantifiable percentage observational measurement of dilation of the magnified veins and arteries of the skin. A photograph of blood flow and vessel dilation was taken at the end of a 10 minute control / rest period. After the rest period the underside of the reclined skin was submitted to 10 minutes of cycloidal vibration and any change in blood flow and vessel dilation was observed estimated and photographed. This was repeated with 20 mice N=20.



Fig 1. Vibro-Pulse

## Discussion

An increase in blood vessel dilation and blood flow was observed, when skin in an in-vivo microcirculatory model was submitted to non-invasive oscillating cycloidal vibrations (Vibro-Pulse). Oscillating vibrations have also shown to increase blood flow in human skin and soft tissue (2-6). A number of mechanisms are considered primarily mechanotransduction.

Vibration increases the eNOS messenger RNA expression and eNOS promoter as a direct action of pulsatile sheer mechanical forces to the endothelium. This produces nitric oxide (NO) via endothelial synthase (eNOS) a cellular signal to the surrounding smooth muscle to relax, resulting in vasodilation (7,8). Nitric Oxide has been shown to be a stimulant in the wound healing process and also has an in direct anti-inflammatory and antitumorigenic action due to suppression of key inflammatory mediators, the forming of peroxynitrate (NO<sub>3</sub>) a strong toxic oxidant with antibacterial properties may also be of benefit (9). Studies have shown improvements in the healing of a range of chronic wounds by applying non invasive vibration to the wound and surrounding tissue. (10-12).

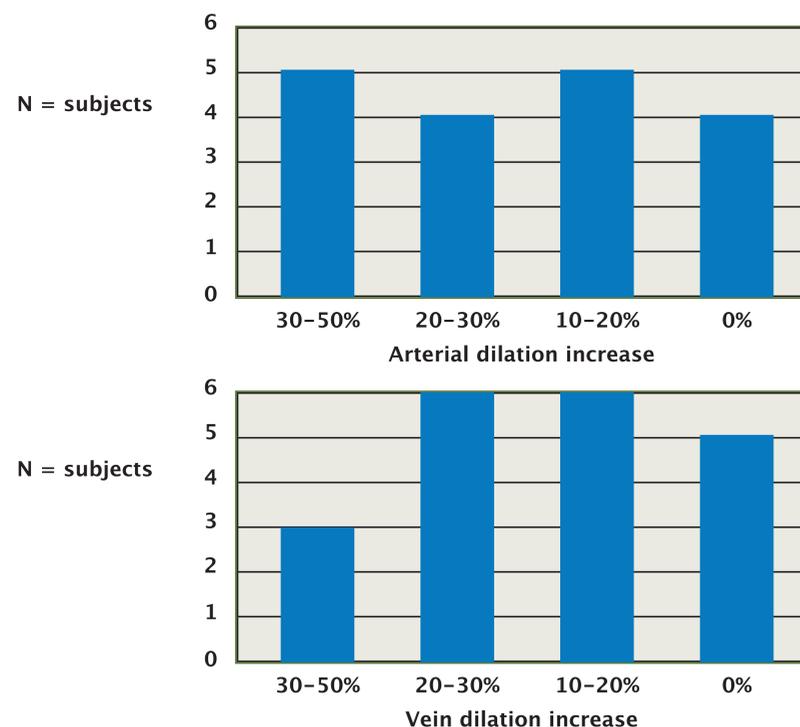
## Conclusion

This preliminary study observed an increase in blood vessel vasodilation and flow in an in-vivo microcirculatory model due to the non-invasive application of oscillation vibration to the skin. Improving skin and soft tissue blood flow can improve the healing of wounds caused by impeded circulation and tissue ischemia. Further research is required and proposed.

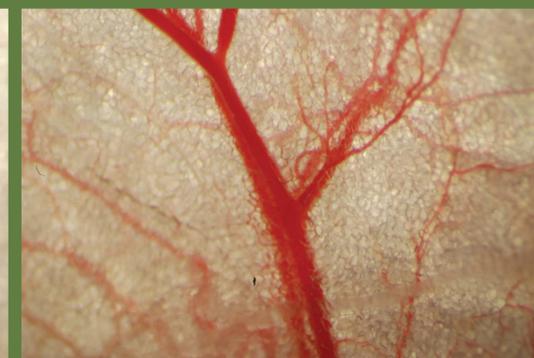
## Results

After 10 minutes rest period when submitted to 10 minutes of cycloidal vibrations an increase of arterial blood vessel dilation by up to 50% was observed in 14 (70%) of cases. 4 (20%) showed no change and 2 (10%) no information could be recorded. Mean dilatation of the artery total of scores ( 28 ) / 18 = 1.56 with a general increase of 17 %.

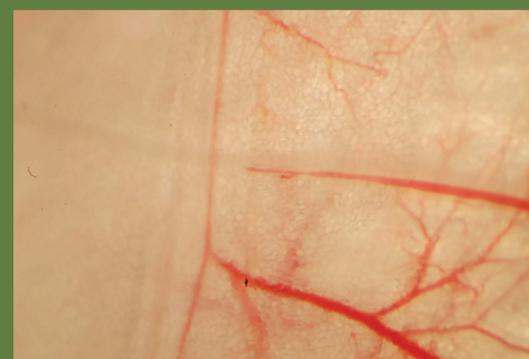
Dilation of the vein was also noted. After 10 minutes of cycloidal vibrations an increase in vein dilation by up to 50% was seen in 15 (75%) of cases. 5 (25%) showed no change. mean dilatation of veins total of scores ( 27 ) / 20 = 1.35 ( general increase of 13 % ).



N1. blood vessels. START at REST



N2 blood vessels AFTER 10 minutes of cycloidal vibration.



N1. blood vessels. START at REST



N2 blood vessels AFTER 10 minutes of cycloidal vibration.

## Acknowledgements

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