

Effect of vibration on localized tissue oxygenation

INTRODUCTION

- Localized vibration therapy: used to improve blood flow and support tissue recovery.[1]
- Study evaluates Effects of mechanical vibration on gastrocnemius muscle oxygenation using Near Infrared Spectroscopy (NIRS).[2][3]
- Hypothesis: localized vibration will increase local tissue oxygenation and vasodilation.



Fig:1 NIRS optodes placement on gastrocnemius muscles

METHODS

- Participants: 8 healthy adults, screened
- Baseline(5 min): Resting tissue oxygenation.
- Vibration(2min): Localized stimulation.
- Recovery (5 min): Passive rest monitoring.
- Tissue oxygenation levels were measured during baseline, vibration, and recovery phases.
- Equipment: NIRS biosensors (Artinis), Handheld vibration device (Elefor), Software: MATLAB

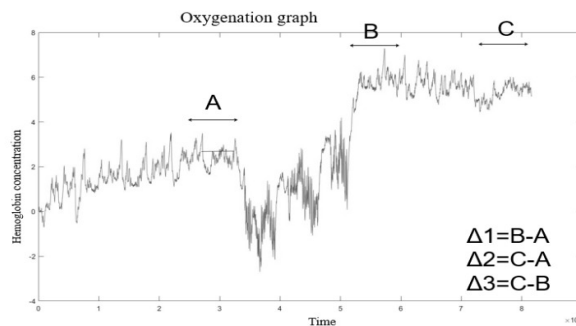


Fig:2 Visualization of raw oxygen concentration data, Pre(A), Post(B), and Recovery(C), respectively.

RESULTS

- OHb and THb levels significantly increased post-vibration.
- THb rose by:
 - Difference (PRE → POST): 130% ($p < 0.05$)
 - $\Delta 2$ (PRE → RECOVERY): 165% ($p < 0.05$)
 - $\Delta 3$ (POST → RECOVERY): 20% ($p > 0.05$)
- OHb remained elevated into the recovery phase.

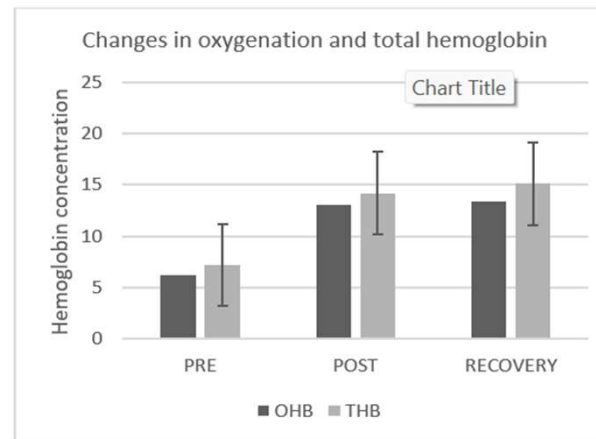


Fig:3 Mean OHb and THb across conditions (Pre, Post, Recovery)

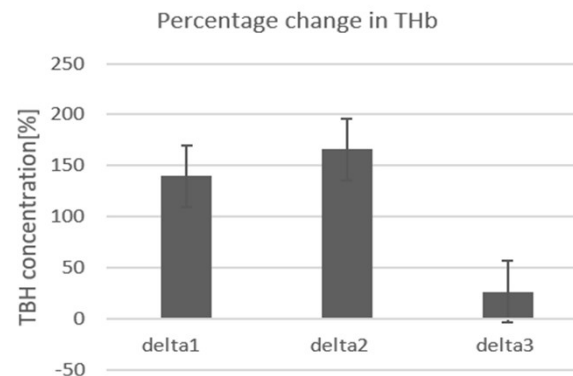


Fig:4 Percentage changes in THb between conditions

SUMMARY

- Vibration promotes vasodilation and nitric oxide-mediated capillary recruitment.
- Localized vibration therapy resulted in a statistically significant increase in both OHb and THb from baseline to post and recovery phases ($p < 0.05$).
- The lack of significant change between POST and RECOVERY implies that the vascular benefits induced by vibration are sustained, but not further elevated during recovery.
- This supports the hypothesis that mechanical vibration induces vasodilation and enhances microvascular oxygen delivery, with effects persisting beyond the active stimulation phase.

CONCLUSIONS AND FUTURE DIRECTIONS

- Localized vibration significantly improves tissue oxygenation and blood volume in skeletal muscle.
- Effects persist into recovery, indicating prolonged physiological benefits.
- NIRS is a reliable tool for dynamic tissue oxygenation monitoring.
- Supports clinical and athletic applications in recovery and rehabilitation.
- Optimize frequency and amplitude for targeted outcomes.
- Explore long-term vascular adaptations to repeated vibration.
- Compare efficacy with other therapeutic modalities like massage and EMS.

REFERENCES

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