

**DEVELOPMENT OF NEGATIVE PRESSURE WOUND  
CARE SYSTEM WITH A NOVEL CONTROL CONCEPT  
AS AN ALTERNATIVE TREATMENT METHOD FOR  
NON-HEALING WOUNDS**

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Engineering

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## ABSTRACT

Negative Pressure Wound Therapy (NPWT) is a noninvasive system that creates a localized, controlled sub atmospheric (negative) pressure environment conducive for wound healing. However, this alternative treatment is yet to acclaim widespread recognition throughout the medical community as a standard treatment method due to the lack of scientifically conducted research data confirming its effectiveness. Most of the available negative pressure wound care systems are of proprietary design and offer limited controls for the medical researcher. The purchase price of the wound care device as well as the consumables is comparatively high especially for a developing country like Sri Lanka. These factors prove to be a hindrance and limit the possibility of gathering data and carrying out medical research. Our project is aimed at developing a negative pressure wound therapy system which is superior in functionality, yet affordable so that it could be widely adopted for treatment as well as research purposes. In our effort we were able to develop and successfully implement a novel concept to control a vacuum by controlled injection of atmospheric air into the system. The developed machine automatically generates, monitor and maintain a given negative pressure in and around the wound being treated. Specific emphasis was given for two major factors during the project.

- Offering maximum flexibility and ease of operation for carrying out medical research during the clinical trials
- Developing a reasonably priced –yet reliable NPWT device suitable for general use

Diabetic patients with resistant ischaemic foot ulcers without granulation were treated during the clinical trials using the device. Using the new NPWT device, we tested a pulsating vacuum profile which is generally recommended for wound treatment. The patients were ambulatory and comfortable throughout the duration of negative pressure therapy. A dramatic increase in healthy granulation with reduction in purulence of the exudates and a significant reduction in wound width was noted in all treated wounds. All the wounds were ready for grafting after a treatment period of two weeks thus, proving the suitability of the system for wound treatment.

Key words: Negative pressure wound therapy, NPWT, high speed valve,

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## LIST OF ABBREVIATIONS

NPWT	-	Negative Pressure Wound Therapy
FDA	-	Food and Drug Administration
VAC	-	Vacuum Assisted Closure Therapy
P	-	Pressure
V	-	Volume
m	-	Mass
$\rho$	-	Density
M	-	Molar mass [kg / kmol]
R	-	General gas constant $R = 8.314510 \text{ kJ} / (\text{kmol K})$
T	-	Thermodynamic temperature [K]
n	-	Molecular number density [ $1 / \text{m}^3$ ]
k	-	Boltzmann's constant $k = 1.380 \cdot 10^{-23} \text{ J/K}$
$Q_L$	-	Leakage rate
$Q_p$	-	Flow rate of vacuum pump
$Q_v$	-	Flow rate through the Valve
PID	-	Proportional Integral Derivative
P	-	Set pressure
$\Delta P$	-	Pressure band
$P_H$	-	Pressure band upper value
$P_L$	-	Pressure band lower value



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