# Design of a New Concept of Anti-siphon Device for Pressure-Activated Shunts: The 'Paddle Wheel Valve'

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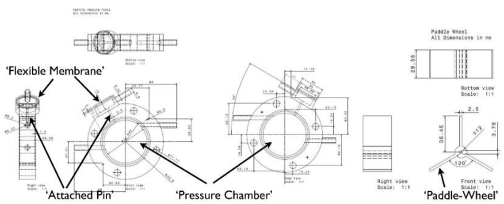
## Introduction

Although several improvements have been observed in the latest years in shunt technology, current available systems still present several associated problems. Among these 'overdrainage' and its complications remains one of the great challenges for new shunt designs.

**Figure 1**

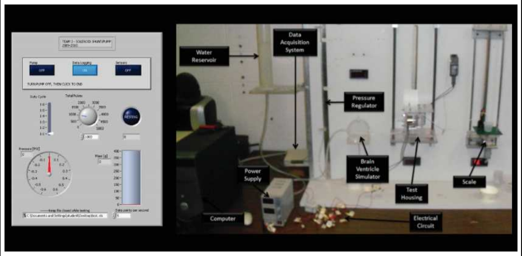



Schematic drawing of the new 'Paddle Wheel Valve' design.

## Methods

The authors employed computer models to theoretically evaluate the mechanical variables involved in shunt operation such as: the fluid's 'Reynolds number', 'proximal pressure', 'distal pressure', 'pressure gradient', 'actual flow rate' and 'expected flow rate'. After fabrication of the first superscaled model, the authors performed benchmark testings in order to analyze the performance of the new shunt device, and its actual functioning in comparison to the results predicted by the mathematical models.

**Figure 5**

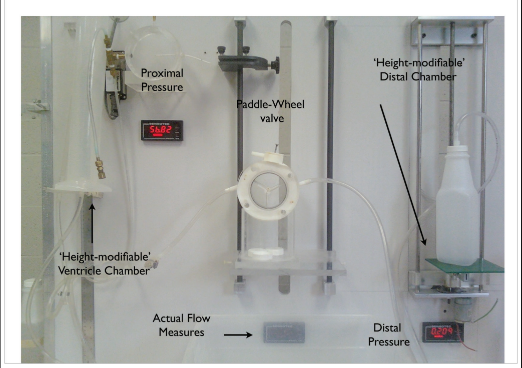


LabView® program control used for the benchmark testings.

## Results

The final 'Paddle Wheel Valve' was designed with a 3-key components system composed by a 'Pressure Chamber', a 'Flexible Membrane' and an attached 'Locking-Pin' enabled the shunt flow depends only on the intracranial pressure and not on the pressure gradient across the valve. Further testings were performed in order to prove that the siphoning effect did not occured in this final model.

**Figure 2**

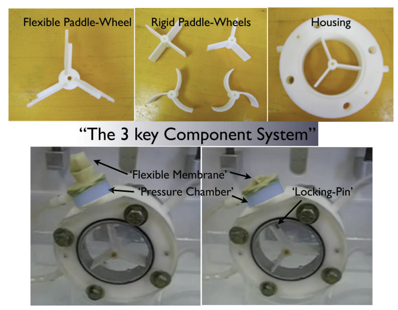



Experimental setup for empirical testings of the new 'Paddle Wheel Valve'

## Conclusions

The design of the 'Paddle Wheel Valve' demonstrated that it is possible to decouple the activation pressure and the pressure gradient across the valve, avoiding the 'siphoning effect'. Although further developments are necessary in order to provide a model compatible to clinical use, the authors believe that this new prototype may be an interesting solution for future attempts addressing the solution of the problem of overdrainage due to siphoning.

**Figure 1**




Upper: Flexible (initial design) and Rigid (final) Paddle Wheels and Housing. Lower: The 3 key component system of the final rigid 'Paddle Wheel Valve'

## Learning Objectives

- To realize the importance of the 'siphoning effect' on the design of new shunt models.

- To be able to explain the variables involved in a new shunt design.

- To explain the basic principle of the new 'paddle-whell' model as an alternative to overcome the siphoning effect

## References

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