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PROJECT COMPLETION REPORT

1. **Project Number** : P6229

2. **Title of the Project** : Reverse Suction and Suction Arrester Device

3. **Funding Agency Name** : TDF SCTIMST

4. **Project Reference Number provided by the Funding Agency**: P6229

5. **Principal Investigator (Name & Address) : Er Anoop Gopinathan, DMDE, BMT Wing, SCTIMST**

6. **Co-Investigators (Name & Address):**

   i. Er

   Muraleedha

   ran C V,

   DMDE

   BMT Wing

   SCTIMST

ii. Dr Tobin George, Neurosurgery, SCTIMST

iii. Dr Mathew Abraham, Neurosurgery, SCTIMST

iv.

7. Implementing Institution : SCTIMST

8. Collaborating Institutions : None

9. Date of Commencement : 22/10/2018

10. Duration : 1.5 years

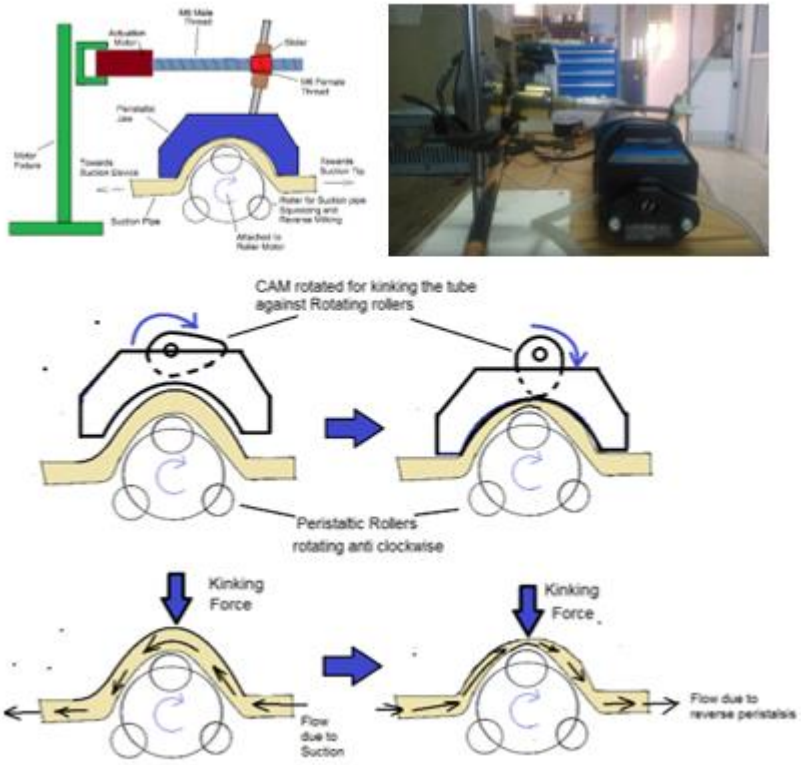
11. Date of Completion : February 2020

12. Objectives as approved : The tissue blockage in the surgical site in Neurosurgery is a common phenomenon which needs to be addressed. A setup which reverse the pressure is required.

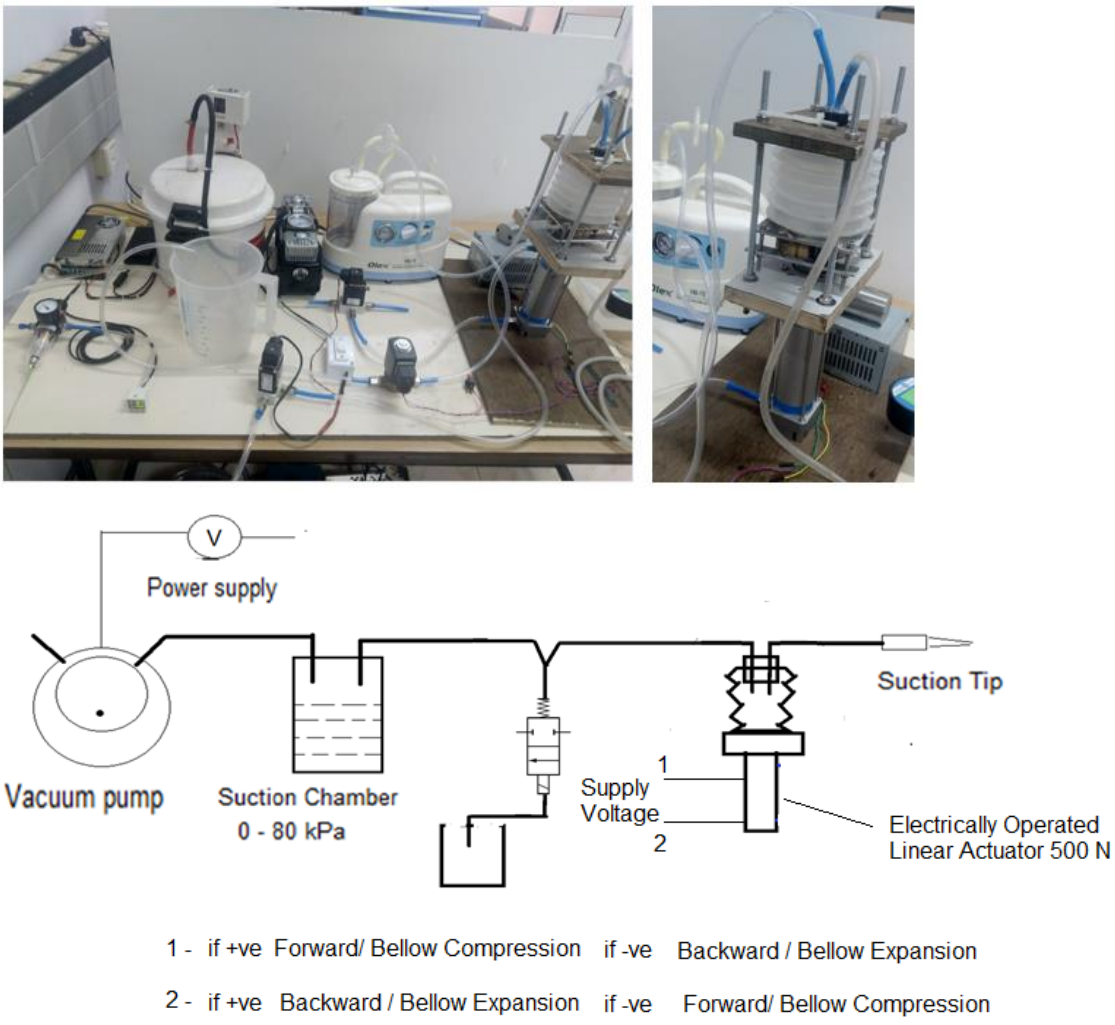
13. **Deviation made from original objectives if any, while implementing the project and reasons thereof :** None

14. **Field/Experimental work giving full details of summary of methods adopted, data collected supported by necessary tables, charts, diagrams and photographs :**

Two different types of reverse pressure setup was prepared – 1, Roller based setup 2, Linear Actuator based setup.



Figure/Image 1: The Roller based Reverse Milking Setup



Figure/Image 2: The Linear Actuator based reverse pressure setup

15. Detailed anaylsis of results :

The Linear actuator-based setup was giving a back pressure at tip from 1kPa to 5 kPa. The roller-based setup was giving pressure below 1 kPa.

16. Summary sheet of not more than 2 pages under following heads :
(Title, Introduction, Rationale, Objectives, Methodology, Results, Translational Potential)

Introduction:

The project seeks to address a critical challenge in neurosurgery—the obstruction of suction devices used to evacuate fluids from surgical regions. The primary concern centers around the entanglement of soft tissues and blood vessels at the suction tip, posing imminent risks of vessel damage and life-threatening hemorrhage.

Rationale:

Within the realm of neurosurgery, existing suction devices encounter formidable challenges when tissues within dissected brains and blood vessels become ensnared with surgical nozzles. This predicament elevates the risk of vessel damage and catastrophic hemorrhage. The project, therefore, endeavors to pioneer a suction device endowed with innovative reverse mechanisms to comprehensively mitigate these pressing issues.

Objectives:

The multifaceted objectives of the project encompass:

Formulating a system adept at generating a counterforce to avert the rupture of soft tissues and blood vessels ensnared at the suction tip.

Introducing a symbiosis of arresting and milking mechanisms to engender augmented back pressure.

Systematically exploring diverse milking mechanisms, including suction kinking, compressible bellow, and pneumatic direct air methodologies.

Integrating supplementary arresting mechanisms, such as motor-based tube arresters and bypass solenoid valve-based mechanisms, to fortify back pressure.

Methodology:

The project's modus operandi encompassed the integration of various reverse mechanisms, including suction kinking and reverse milking, compressible bellow-based designs, and pneumatic direct air mechanisms. Further augmentation involved delving into additional arresting mechanisms, such as motor-based tube arresters and bypass solenoid valve-based mechanisms. The team conducted intricate experiments to scrutinize blockage retraction

dynamics and meticulously gauged pressure responses at the suction tip using diverse methodological approaches.

Results:

Observations at the suction tip unveiled the efficacy of reverse milking, bellow compression, and pneumatic back pressure mechanisms in seamlessly retracting mild obstructions. For more formidable blockages, pneumatic and bellow compression mechanisms emerged as the preeminent solutions. However simple Pneumatic reverse pressure mechanism was more unsafe as per the feedback from the clinicians. The bellow compression mechanism was capable to provide back pressure upto 5 kPa and the roller based mechanisms gave back pressure below 1 kPa

Translational Potential:

The innovatively devised suction device, boasting a suite of reverse mechanisms, exhibits promising translational potential in revolutionizing neurosurgical procedures. Its capacity to adeptly manage blockages and furnish controlled back pressure not only elevates the safety quotient but augments the operational efficiency of the suction device, thereby significantly reducing the likelihood of complications during neurosurgical interventions.

17. Contributions made towards increasing the state of knowledge in the subject :

The development of this device has paved the way for implementing safer techniques in addressing surgical issues. Additionally, the project has created opportunities for the alternative utilization of clinically established surgical items, such as the bellow, enhancing their efficacy in dealing with a diverse range of problems

18. Conclusions summarising the achievements and indication of scope for future work :

Observations at the suction tip unveiled the efficacy of reverse milking, bellow compression, and pneumatic back pressure mechanisms in seamlessly retracting mild obstructions. For more formidable blockages, pneumatic and bellow compression mechanisms emerged as the preeminent solutions. However simple Pneumatic reverse pressure mechanism was more unsafe as per the feedback from the clinicians. The bellow compression mechanism was capable to provide back pressure upto 5 kPa and the roller based mechanisms gave back pressure below 1 kPa

19. Science and Technology benefits accrued :

a. List of research publications with complete details : Nil

b. Manpower trained on the project :

i.	**Research Scientists or Research Fellows**	**:**	**Nil**
ii.	**No. of PhD's produced**	**:**	**Nil**
iii.	**Other Technical Personnel trained**	**:**	**Mr Anosh Kumar worked in this project as Project Assistant**

c. Patents taken, if any : 2 patents applied

1, Patent Application No. 202141034127
Title: An enhanced surgical suction system with a roller based reverse pressure device
2, Patent Application No: 202341078956
Title: A Surgical Suction System

d. Products developed, if any : Two different types of Reverse Pressure Setups were developed

20. Abstract: (In 300 words for possible publication in ..... Bulletin)

a. Background: Neurosurgical procedures often encounter challenges related to the obstruction of suction devices, particularly in the entanglement of soft tissues and blood vessels at the suction tip. This study addresses this critical issue by developing and validating innovative reverse mechanisms aimed at enhancing the efficacy of suction devices in neurosurgery.

b. Materials: The project involved the integration of novel reverse mechanisms, including suction kinking, compressible bellow, and pneumatic direct air methodologies.
Additional arresting mechanisms, such as motor-based tube arresters and bypass solenoid valve-based mechanisms, were explored to comprehensively address back pressure concerns.

c. Results: Empirical experimentation validated the effectiveness of the developed mechanisms. Positive pressure responses, particularly with the pneumatic direct air mechanism, showcased practical viability. Transparent documentation of limitations provided a realistic understanding of the study's boundaries. The study also identified translational potential, offering tangible applications to improve safety and efficiency in neurosurgical procedures.

d. Conclusion: The successful development and validation of diverse reverse mechanisms mark a significant achievement in addressing suction device challenges. The study's findings affirm its potential for practical implementation in neurosurgical settings, emphasizing enhanced safety and procedural efficiency. Acknowledging study limitations ensures a nuanced interpretation of results. Moving forward, the exploration of refined reverse mechanisms, integration of human factors, long-term durability studies, and collaborative research opportunities will be pivotal for continuous advancements in suction device technology. This study lays the groundwork for future research endeavors aimed at optimizing suction devices for neurosurgical applications.

21. Procurement/Usage of Equipment:

a. Details of Equipment:

Sl. No.	Name of Equipment	Make/ Model	Cost (Rs.)	Date of Installation	Utilisation	Remarks regarding

						maintenance breakdown
1	**Air compressor**	**Eko Green**	**3750**	**12/04/2019**	**Used specifically for the setup**	
2	**Linear Actuator**	**Rotlinear**	**6300**	**23/06/2020**	**Used for bellow compression**	

b. Suggestions for disposal of equipment(s):

The disposal strategy followed in Electrical and Electronic items could be followed.

(Name and Signature of PIs with date)

Routing: *Signed copy of "Project completion Report" by PI → root@sctimst.ac.in, rpc@sctimst.ac.in*