

# A Novel Brain Biopsy Cannula for Safe and Adequate Tissue Acquisition

Yitian Xian<sup>1</sup>, Limin Zou<sup>2</sup>, Danny Tat Ming Chan<sup>1</sup>, David Yuen Chung Chan<sup>1</sup>, and Zheng Li<sup>1,3,4,5</sup>

<sup>1</sup> Department of Surgery, The Chinese University of Hong Kong

<sup>2</sup> Department of Biomedical Engineering, The Chinese University of Hong Kong

<sup>3</sup> Li Ka Shing Institute of Health Sciences, The Chinese University of Hong Kong

<sup>4</sup> Chow Yuk Ho Technology Centre for Innovative Medicine, The Chinese University of Hong Kong

<sup>5</sup> Multi-scale Medical Robotics Centre, The Chinese University of Hong Kong

## Background & Objective

- Brain biopsy is a gold standard to determine the type and grade of brain tumors.
- In current clinical practice, the application of vacuum pressure is based on neurosurgeons' experience, which may lead to excessive tissue removal or even haemorrhage.
- In this study, we evaluate the effectiveness and safety of a novel brain biopsy cannula with comparison to a Laitinen type manual cannula from BrainLAB.

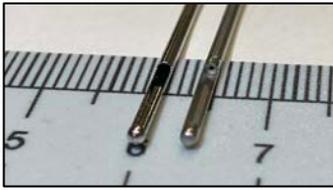


Fig 1. The Laitinen type manual cannula and proposed cannula.

## Methods

- An in vitro experiment was setup by using fresh swine brains, the brain biopsy cannulas (manual cannula or the proposed cannula) and a syringe based vacuum pressure generator, as shown in Fig. 2.
- Each cannula was tested on a swine brain in a pressure range of -20 to -70 kPa with 10-kPa interval and the tests were repeated four times. Weight of acquired tissues were measured using an electrical scale.
- When the tissue fully fills the cutting window, its weight is 16.10 mg (average density of swine brain is 1.046 mg/mm<sup>3</sup>; volume 15.40 mm<sup>3</sup>) [1]. Also, effectiveness in histopathological examination can achieve 98% when the sample weight is 10.45 mg [2]. We consider tissue with weight between **10.45 mg and 16.10 mg** is adequate.

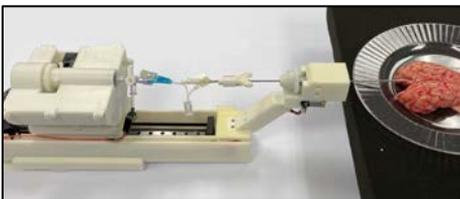


Fig 2. Experimental setup.

## Results

- A total of 48 samples are acquired and shown in Fig. 3 and 4.
- For the manual cannula, the average sample weights increase significantly along with the pressure. When the vacuum pressure is beyond **-30 kPa**, all samples are **excessive**.
- For the proposed cannula, the biopsy yield is less affected by the vacuum pressure. Within the pressure range of -20 kPa and -70 kPa, the average biopsy yield under each pressure falls in the adequate range. The average tissue amount of all the samples is **12.14 mg**.

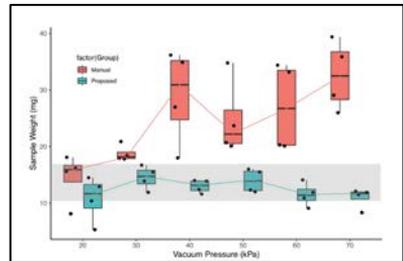


Fig 3. Sample weight of manual cannula and proposed cannula.

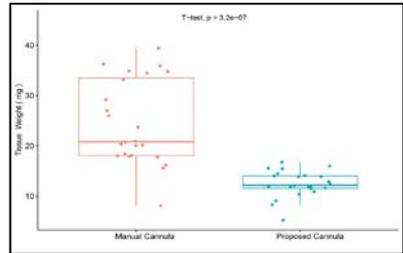


Fig 4. Sample weight distribution of manual cannula and proposed cannula.

## Results

The proposed brain biopsy cannula is effective and could avoid tissue excess compared to the Laitinen type manual cannula ( $P < 0.01$ ).

### Reference

- [1] M. Ye, "Design and development of a semiautonomous stereotactic brain biopsy robot with enhanced safety," M.S. Thesis, Dvi. of Surgery, CUHK, Hong Kong, 2020. Accessed on: Jan., 15, 2020. [Online]. Available: [https://repository.lib.cuhk.edu.hk/en/item/cuhk-2628062?solr\\_nav%5Bid%5D=85d9448b224c863fd61b&solr\\_nav%5Bpag-e%5D=0&solr\\_nav%5Boffset%5D=0](https://repository.lib.cuhk.edu.hk/en/item/cuhk-2628062?solr_nav%5Bid%5D=85d9448b224c863fd61b&solr_nav%5Bpag-e%5D=0&solr_nav%5Boffset%5D=0)
- [2] Trojanowski, B. Jarosz, and D. Szczepanek, "The diagnostic quality of needle brain biopsy specimens obtained with different sampling methods—experimental study," Scientific reports, vol. 9, no. 1, pp. 1–7, 2019.