Investigating Surgical Dexterity of the Da Vinci Surgical Robot with the Usage of Chopsticks

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ABSTRACT

This study is intended to evaluate the performance and correlation between using chopsticks and using the da Vinci surgical robot for medical students at the Brody School of Medicine.

The study was developed to address the growing costs of surgical skills training in medical students, residents, and attending physicians.

HYPOTHESIS

We hypothesize that students who perform well on the chopstick manipulation test in phase 1 will also have a high performance with using the da Vinci surgical robot in phase 2.

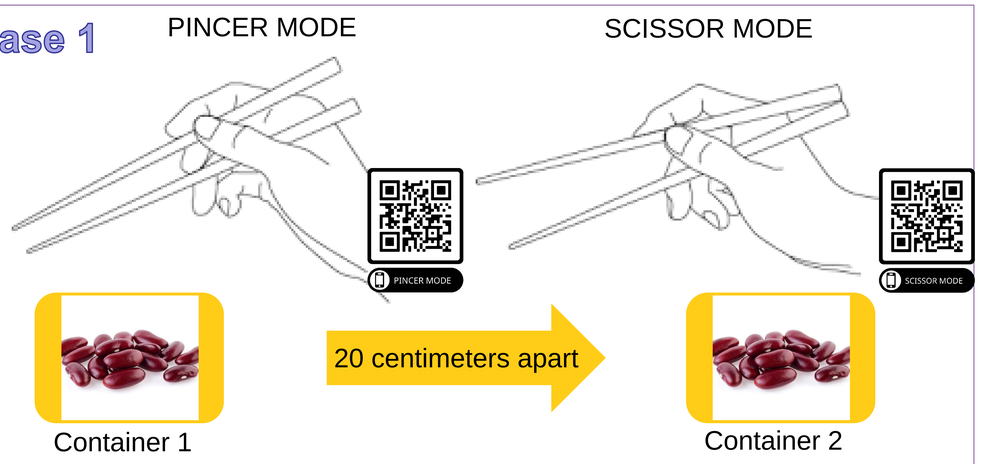
BACKGROUND

"Chopstick" surgery is a growing form of surgical education that may enhance a surgeon's ability to move, navigate, and direct the precision and accuracy of surgical equipment in the 21st century.[2]

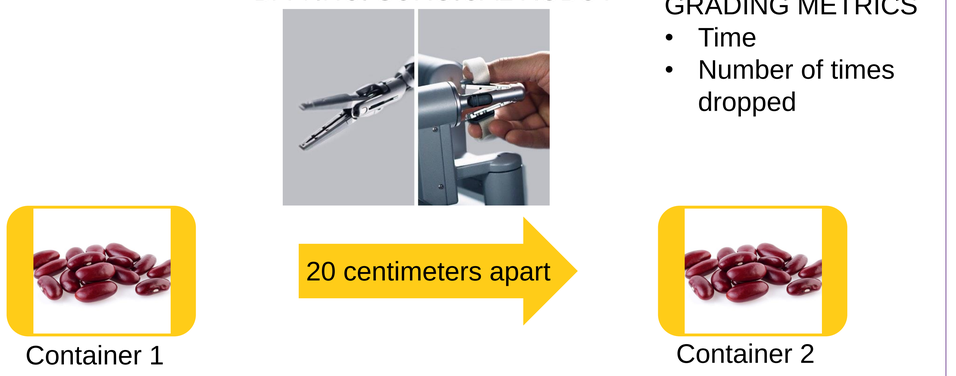
A study by Danzer et al, estimated that a 4-week dedicated simulation rotation within a general surgery residency dedicated to surgical hand dexterity costs $12,516 per resident.[1] A correlation in using traditional chopsticks and the Da Vinci Machine may provide surgeons with a cost-effective method of training.[1,3] Since the mechanics of performing surgery with the Da Vinci Surgical Machine mimic similar hand movements of using traditional chopsticks, we propose that a relationship may exists between manual dexterity and varying degrees of chopstick mastery.[4]

EXPERIMENTAL SETUP

Phase 1



Phase 2



REFERENCES

1. Danzer E, Dumon K, Kolb G, Pray L, Selvan B, Resnick AS, Morris JB, Williams NN. What is the cost associated with the implementation and maintenance of an ACS/APDS-based surgical skills curriculum? J Surg Educ. 2011 Nov-Dec;68(6):519-25. doi: 10.1016/j.jsurg.2011.06.004. PMID: 22000539.
2. Wang, Y., Yao, Y., Dou, Y. et al. Chopstick technique used in laparoendoscopic single site radical hysterectomy for early stage cervical cancer. Sci Rep 11, 6882 (2021). https://doi.org/10.1038/s41598-021-85783-5.
3. Jiang DJ, Wen C, Yang AJ, Zhu ZL, Lei Y, Lan YJ, Huang QY, Hou XY. Cost-effective framework for basic surgical skills training. ANZ J Surg. 2013 Jun;83(6):472-6. doi: 10.1111/j.1445-2197.2012.06289.x. Epub 2012 Oct 4. PMID: 23035901.
4. Shimomura Y, Ohsawa T, Shimura M, Xia Y, Iwanaga K, Katsuura T. What is the significance of the traditional pinching mode of holding chopsticks? J Physiol Anthropol. 2020 May 4;39(1):13. doi: 10.1186/s40101-020-00223-z. PMID: 32366321; PMCID: PMC7197175.
5. Li-Tsang, Cecilia & LEE, HCY & HUNG, LK. (2006). Validation of a Chopsticks Manipulation Test for Screening Chinese Children with Fine Motor Dysfunction. Hong Kong Journal of Paediatrics. 11.

METHODS

The study population consists of 20, preclinical and clinical, medical students identified by convenience sampling who are interested in a career in surgery. The study will assess the usage of chopsticks in both hands of each medical student and attempt to translate it to the da Vinci surgical robot. Potential confounding factors were gathered in the initial phase of the study. The research will be divided into two phases.

- In the first phase of the study, chopstick abilities will be assessed.
- In the second phase of the study, participants will use the da Vinci surgical robot to complete the same tasks to test for applicability of chopsticks to the da Vinci surgical robot.

1. Chopstick proficiency will be measured by picking up 10 kidney beans from a container and placed into another container that will be placed 20 centimeters away.
   a) In the case that a kidney bean is dropped, the student is required to place the kidney bean back into the original container and the process must be repeated until all the kidney beans are successfully transferred.[5]
2. The same experiment will be performed on the da Vinci surgical robot.
3. A debriefing session will be conducted with each individual after the conclusion of the experiment.

All data will be analyzed using Microsoft Excel and Statistical Package for the Social Sciences (SPSS). Pearson's correlation will be used to assess the relationship between using chopsticks and the da Vinci surgical robot. Three-way ANOVA tests will be used to assess factors affecting chopstick performance and robotic performance pertaining to age, gender, and prior chopstick proficiency.

ACKNOWLEDGEMENTS

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