

## MEASUREMENT OF TROCAR INSERTION AND EXIT FORCE DURING APPLICATION OF TENSION-FREE VAGINAL TAPE FOR THE TREATMENT OF FEMALE STRESS URINARY INCONTINENCE

### Hypothesis / aims of study

To establish a model to measure the force required for transvaginal trocar insertion using a single transducer made from piezoresistive material during application of tension-free vaginal tape (TVT).

### Study design, materials and methods

This was a prospective observational study designed to measure the TVT trocar insertion force. The authors' institutional ethics review board approved the study. Standardized, conventional TVT procedures were performed in this study [1], and the trocar insertion and exit forces were measured on both sides. A 3.5 x 3.5 cm pressure transducer was constructed from piezoresistive material (2 mm-thick semiconductive fabric; FSA, Vista Medical Ltd., Winnipeg, Manitoba, Canada), which changed its impedance as force was exerted on its surface. The transducer was connected via an interface unit to a laptop computer to digitally record the pressure profile (Pressure = Force / Area, with Area assumed to be constant) continuously during trocar application [2]. The measured pressure profile was recorded in mmHg. The transducer and attached wires were enclosed inside a sterilized plastic cover and positioned in the center of the palm of the surgeon's dominant hand. The plastic cover was affixed to the surgeon's glove with adhesive tape to maintain the transducer's position. The handle of the trocar was positioned in the center of the transducer. As the trocar was inserted through the vagina, the data-collection unit recorded the mechanical force exerted through the transducer by the surgeon onto the trocar. The procedure and recording were repeated on the contralateral side. Measurement data were recovered continuously from the data-collection unit and stored electronically on a laptop computer every 22 msec from the time of insertion of the trocar until the trocar exited through the abdominal incision. The profile obtained over time was examined to determine maximum contact pressure recorded for each application. All the TVT procedures were performed by the same surgeon.

### Results

Recordings were successfully obtained from 24 patients. There was no instance of transducer failure. The mean (standard deviation) age, height, and weight of the patients were 64.4 (11.7) years, 61.1 (11.4) kg, and 155 (8.6) cm respectively. All the patients were multiparous, and the TVT procedure was performed under local anesthesia in 11 women (46%). The mean (standard error) peak contact pressure during application of the trocar on the patients' right and left side vaginal wall, and right and left side abdominal wall were 54.2 (6.4) mmHg, 55.7 (10.8) mmHg, 128.5 (15.6) mmHg, and 128.5 (15.7) mmHg respectively. Pairwise comparisons between trocar insertion and exit force showed a statistically significant difference in the peak application forces between both right and left sided vaginal insertion force, and right and left sided abdominal exit force ( $p < 0.001$ ) [Figure 1]. There was no correlation between patients' age, height, weight, and degree of force used by the operator. There was a trend toward the operator using greater force during the trocar insertion and exit procedure in women who had a general anesthesia as compared to those who had only a local anesthesia [Figure 2].

### Interpretation of results

Substantially more force is necessary for abdominal exit than vaginal insertion of the trocar during the TVT procedure, regardless of side. This can be interpreted clinically that greater care should be exercised by the surgeon during abdominal exit of the TVT trocar, in order to avoid inadvertent damage of the anterior abdominal tissues.

A low force is expected during vaginal insertion of the trocar. This can be interpreted clinically that surgeons should redirect the trocar during vaginal insertion when unexpectedly excessive

force is required. Alternatively, the surgeon should look out for inadvertent injury (bladder in particular) if unexpectedly excessive force has been used during vaginal insertion of the trocar.

Concluding message

A simple model has been developed by which trocar insertion force can be easily and objectively measured.

The TVT trocar abdominal exit force is substantially greater than the vaginal insertion force, regardless of side.

References

1. An ambulatory surgical procedure under local anesthesia for treatment of female urinary incontinence. *Int Urogynecol J Pelvic Floor Dysfunct* 1996;7:81-5.
2. Measurement of trocar insertion force using a piezoelectric transducer. *J Am Assoc Gynecol Laparosc* 2003;10:55-9.

Figure 1: Relative mean peak entry and exit force, expressed in mmHg. Error bars indicate the value of the Standard Error of the mean for a given trocar vaginal entry and exit force.

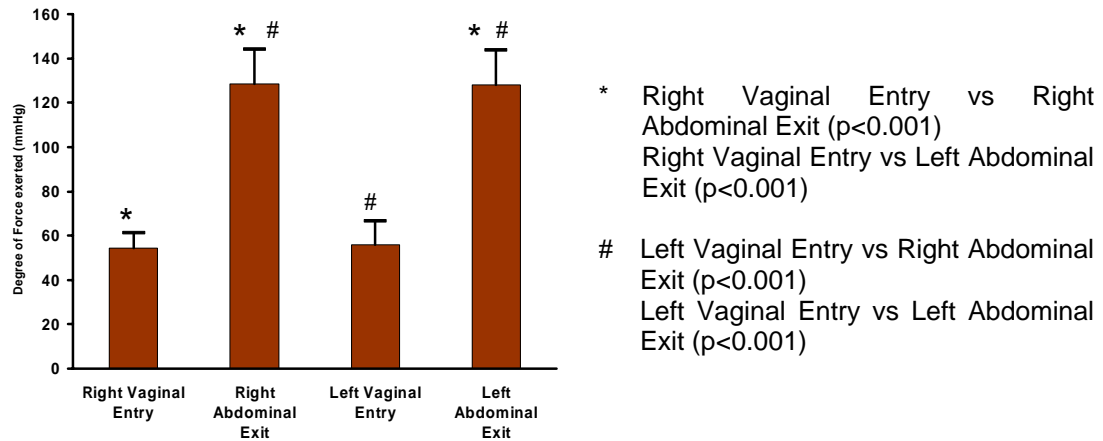
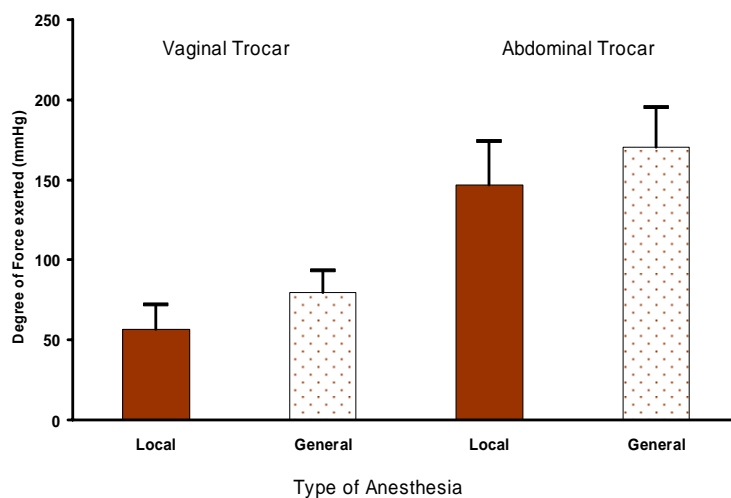


Figure 2: Relative mean peak entry and exit force, expressed in mmHg for maximum vaginal and abdominal reading obtained during application of either the left or right vaginal trocar or left and right abdominal trocar according to type of anesthesia administered to the patient. Error bars indicate the value of the Standard Error of the mean.



**FUNDING: Direct Grant for Research, The Chinese University of Hong Kong**