Pelvic organ prolapse (POP) is a disease that is usually not life-threatening but can seriously affect the life quality of patients. It is currently believed that there is a significant correlation between POP and cervical elongation. In POP surgery, cervical length has a critical impact on the choice of surgical approach and decision making of uterine conservation. It remains unclear how to evaluate the length of the cervix before surgery. In particular, there is a lack of cervical length data in Chinese women with POP.

POP quantitation (POP-Q) is a widely used method for assessing the degree of POP worldwide. It is first used in China in 2004 and has become a widely used method for assessing the degree of POP since then. In this method, point C represents the most distal edge of the cervix, while point D represents the location of the posterior fornix. It is currently believed that the distance between point C and point D can theoretically reflect the length of the cervix to some extent. However, we have found that the actual length of the cervix is not equal to C-D (the distance between point C and point D) in every case.

In this study, we aimed to examine the cervical length of patients with POP and assess the characteristics of the pelvic floor of Chinese women.

This prospective case study was approved by the Clinical Research Ethics Committee of the Peking University People’s Hospital (No. 2015PHB165). POP patients who were admitted to the Department of Obstetrics and Gynecology, Peking University People’s Hospital from October 2015 to February 2019 were enrolled in our study. Exclusion criteria were set as follows: (1) patients who underwent previously hysterectomy; or (2) patients who were prepared to accept uterine preservation surgery. In the end, a total of 379 patients were enrolled in the present study.

A patient included in the study was examined with POP-Q twice by the same physician before the surgery, including one in the clinic and another one at the hospital, and the results of both examinations were averaged and recorded. The C-D was recorded as POP-Q cervical length (PCL). Subsequently, she was admitted for vaginal hysterectomy by the same physician. The length of the internal os to the most distal edge of the anterior cervix and posterior cervix was recorded as aACL and pACL, respectively. The anatomical cervical length (ACL) was defined as aACL to better match the definition of point C in POP-Q. The correlation coefficient between PCL and ACL in a preliminary study consisting of 30 patients was 0.225. Using the sample size calculation formula for correlation analysis, we calculated that 204 participants would provide the study with 90% power, with a two-sided significance level of 5%.

Statistical analysis was performed using SPSS 22.0 (SPSS Inc., Chicago, IL, USA). All descriptive data were presented as mean ± standard deviation, n (%), or median (P25, P75). Spearman correlation analysis was used to compare the correlation between PCL and ACL. Mann-Whitney U test was used to compare the differences between the two groups.

The mean age of the patients was 67.4 ± 8.8 years. Body mass index (BMI) was 24.8 ± 3.3 kg/m², with gravidity of 1-7 and parity of 0-7. All patients underwent a hysterectomy. A total of 324 operations (85.5%) were transvaginally performed, and 228 patients (60.2%) were repaired with surgical mesh.

All the 379 patients underwent POP-Q measurements before the surgery. PCL calculated by C-D was 3.87 ± 1.72 cm (min 0.5 cm, max 10 cm). The uterus...
was dissected after the operation. ACL was 4.23 ± 1.15 cm (min 2 cm, max 10 cm). ACL < 4 cm was found in 113 cases (29.8%), 4 cm ≤ ACL < 5 cm was found in 166 cases (43.8%), 5 cm ≤ ACL < 6 cm was found in 61 cases (16.1%), and ACL ≥ 6 cm was found in 39 cases (10.3%).

Among all the 379 cases, the difference between PCL and ACL in 305 cases (80.5%) was within 2 cm, while it was within 1 cm in 213 cases (56.2%). The difference between PCL and ACL was 1.43 ± 1.30 cm (min 0 cm, max 7 cm). PCL was significantly correlated with ACL (r = 0.151, P = 0.003). The correlation between Ba and [ACL-PCL] was not significant (r = 0.084, P = 0.104). However, the correlation between the prolapse stage and |PCL-ACL| was significant in patients with uterine prolapse and posterior compartment prolapse (r = 0.193, P < 0.001; r = 0.152, P = 0.003).

The patients were grouped according to whether the |PCL-ACL| was greater than 2 cm. Table 1 shows the difference in POP-Q results between the two groups. There was a significant difference in terms of C, D, and Bp between the two groups with |PCL-ACL| > 2 and |PCL-ACL| ≤ 2. Uterine prolapse and posterior compartment prolapse seemed to have an impact on the prediction of ACL by PCL.

In the present study, we performed a multi-sample analysis on POP-Q data and cervical lengths of Chinese patients. We found that the cervical length was ≥4 cm in 70.2% cases. Moreover, there was a good correlation between PCL and ACL (P = 0.003). In 80.5% of cases, the difference between PCL and ACL was within 2 cm. However, C-D still had its limitations for the accurate prediction of cervical length. First of all, the exact definition of point D remains controversial. Some scholars believe that point D is defined as the attachment point of the uterosacral ligament in the cervix, which is more clinically meaningful, and such definition ensures that point D would not be omitted in the absence of a cervix because it reflects the attachments of the uterosacral ligaments to the upper posterior vagina post hysterectomy.[4] Under this definition, C-D is more accurate in reflecting the cervical length. However, we found that it was very difficult to see and palpate the uterosacral ligament insert into the posterior of the cervix, even when the patient was anesthetized if the uterosacral ligaments were atrophic. In addition, a previous study has also pointed out that the correlation between C-D and cervical length is decreased with the increase of the POP stage,[5] which is consistent with the conclusion of our current study. Meanwhile, in the actual POP-Q measurement process, we also found that the accurate measurements of point D were more difficult in patients with severe uterine prolapse or posterior compartment prolapse. The inaccuracy of the point D measurement limited the value of PCL in predicting the cervical length in patients with severe posterior compartment prolapse. A small number of studies have discussed the relationship between C-D and cervical length. In a study consisting of 202 patients, the difference between C-D and cervical length is within 2 cm in 56.93% of the cases, of which it is within 1 cm in 36.14% of the cases, and the consistency between C-D and cervical length is decreased as the severity of pelvic prolapsed is increased.[5] Compared with these studies, our research has some obvious advantages. First of all, as a prospective study, our research process was more rigorous. Also, we found that [ACL-PCL] was associated with the severity of the uterine prolapse or posterior compartment prolapse. Our research was mainly limited by the sample size. Although statistically significant sample size was included, it was still a single-center study with a small sample size. In addition, the results may not fully represent the Chinese patients.

In summary, there was a good correlation between C-D and cervical length (P = 0.003). In addition, the consistency of C-D and the cervical length were decreased with the severity of uterine prolapse or posterior compartment prolapse. The ACL was ≥4 cm in 70.2% of the cases.

**Declaration of patient consent**

The authors certify that they have obtained all appropriate patient consent forms. In the form the patients have given their consent for their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.
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Conflicts of interest
None.

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