学 位 論 文 の 要 旨

氏名　長島　玲子

学 位 論 文 名	Bladder Neck Moves in a Correlated Manner During Gluteal Muscle and Pelvic Floor Muscle Contractions: Gluteal Muscle Contraction as Easily Confirmable Pelvic Floor Muscle Training
発 表 雑 誌 名 （巻，初頁～終頁，年）	Shimane Journal of Medical Science (in press)
著 者 名	Reiko Nagashima, Noriko Goda, Chiaki Inoue, Hiroki Otani

論 文 内 容 の 要 旨

INTRODUCTION

Urinary incontinence (UI), defined as the complaint of any involuntary leakage of urine, consists of three types: stress, urge, and mixed. Stress urinary incontinence (SUI) is common in females between the ages of 15 and 64, with prevalence ranging from 10% to 30%. It has a negative effect on the quality of life (QOL) of affected women. The pathogenesis of SUI is multifactorial, but weakening of the pelvic floor muscles (PFMs) and connective tissues involved in pelvic support due to aging, childbirth, and other causes, as well as factors related to the position of the urinary bladder neck and intrinsic sphincter tone of the urethra have been implicated. A trial of conservative treatments is often offered before surgical treatment because SUI does not progress in the short term, and pelvic floor muscle training (PFMT) has been reported as an effective conservative treatment. However, despite its benefit, it is not widely recommended in clinics in Japan, at least partly because the mechanism of PFMT and thus the evaluation of its effects have not been fully established. Static and functional magnetic resonance imaging (MRI) has been used in studies of the effects of PFMT, but standards for evaluating the effects have not been fully established. We previously showed that the effect of PFMT could be evaluated by morphologic assessment of the PF supporting tissue using cine MRI. MRI indicated that the bladder neck moved anteriorly and elevated during PFM contraction, indicating improvements in the contractile strength of the PFM. Reports indicate that gluteal muscle (GM) and PFM are activated simultaneously. However, no studies have focused on whether GM contraction affects the bladder neck movement. In the present study, therefore, we compared cine MRI of bladder neck movement between during GM and PFM contractions in order to examine whether GM contraction can be used in PFMT.

MATERIALS AND METHODS

Twenty-four females (3 nulliparous, and 21 primiparous within 6 months of normal vaginal delivery, 29.5 ± 4.5 years, from 21 to 38 years, of age) were included in the study. The International Consultation of Incontinence Questionnaire-Short Form (ICIQ-SF) was used to assess SUI. In order to achieve stronger GM contractions, we instructed participants to contract the gluteus maximus muscle (GMM) towards the midline, so that the buttocks touch. PFM contractions were described to the participants as a movement similar to stopping voiding and illustrations of the PFM were also used. We observed the bladder using a high-speed 1.5-T MAGNETOM Symphony scanner (SIEMENS, Munich, Germany). Scanning conditions were as follows: slice thickness/slice intervals: 5 mm/0.5 mm for cross-sectional images and 5 mm/1 mm for sagittal images; field of view: 220 mm for cross-sectional images and 240 mm for sagittal images; matrix size: 256×205 mm for cross-sectional images and 448×180 mm for sagittal images; and repetition time (TR)/echo time (TE): 4580/111 for cross-sectional images and 3300/100 for sagittal images. The number of excitations (NEX) was assumed to be 2. we conducted a dynamic scan using gradient sequence true FISP (high-speed) cine MRI. The slice thickness/slice intervals were 5 mm/1 mm, with a field of view of 300 mm, matrix size of 256×210, TR/TE of 4.3/2.15, and NEX of 2. Scanning was performed at 1 frame per second to assess movement of the bladder neck. To evaluate mobility of the bladder neck with cine imaging, we measured dorsoventral and craniocaudal movement of the bladder neck in the midsagittal section. The scanning methods were as follows: (1) a 5-s scan at rest, and (2) a 10-s scan of GMM contractions, followed by a 5-min break to allow time for instructions regarding PFM contractions. Scanning resumed with (3) a 5-s scan at rest, followed by (4) a 10-s scan of PFM contractions. Cine images were captured at 1 frame per second, for a total of 30 frames per participant. The height of the bladder neck was defined as the length of the straight line from the bladder neck that is perpendicular to the intersection with the base line connecting the lower end of the sacrum and pubis. The dorsoventral position of the bladder neck was defined as the distance from the sacrum to the bladder neck in a line parallel to the base line. The relationship between the bladder neck height/position and GMM and PFM contractions was evaluated through univariate regression analysis, using the average of maximum values for each participant to determine the correlation coefficient, the value during GMM contraction as the independent variable, and the value during PFM contraction as the dependent variable. Next, we evaluated the sustainability of the 10-s contraction by the test of the uniformity of the distribution of measured values during GMM and PFM contractions. Statistical significance was set at 0.05. The study protocol was approved by the Ethics Committee of The University of Shimane and written informed consent was obtained from all subjects.

RESULTS AND DISCUSSION

By cine MRI, the maximum bladder neck heights during GMM and PFM contractions were highly correlated ($r = 0.946$, $p < 0.001$). The mean heights and patterns of change in the height during 10-s contraction showed a high degree of similarity between GMM and PFM contractions ($p = 0.999$). There was also a high degree of correlation between bladder neck positions during GMM and PFM contractions ($r = 0.999$, $p < 0.001$). The onset of positional change and pattern of change over 10 s were highly similar during GMM and PFM contractions ($p = 0.999$).

The present study using cine MRI revealed a high degree of correlation for both the bladder neck height and dorsoventral position between GMM and PFM contractions. The changes in bladder neck height and position were very similar during GMM and PFM contractions and were maintained through 10 s of contraction. This strongly suggests that voluntary GMM contraction induces associated involuntary PFM contraction to the same degree as voluntary PFM contraction, resulting in very similar changes in the bladder neck movement. Therefore, our results suggest that GMM contractions, which are easier to confirm than PFM contractions, may serve as an effective PFMT.

The GMM and PFM are innervated by somatic motor neurons from the sacral and coccygeal plexuses. The lateral sacral plexus is composed of the S1–S4 nerves and the L4/L5 lumbosacral nerve root. GMM is innervated by the inferior gluteal nerve, which branches off the posterior L5–S2 sacral plexus. On the other hand, the PFMs are innervated by the pudendal nerve originating from the anterior S2–S4 sacral plexus as well as a branch of the sacral plexus. Thus, GMM and PFM innervations share some nerve fibers. The present results together with those of previous studies suggest that voluntary contraction of the GMM, which is easy to confirm by the participant and researcher, induces changes in the height/position of the bladder neck as well as contraction of the external urethral sphincter to the same degree as voluntary contraction of the PFM. GMM contraction therefore may be effective for PFMT.

CONCLUSION

The present study showed that the bladder neck height/position and the distribution of bladder neck height/position were highly correlated between GM and PFM contractions, suggesting that GM contraction effectively induces PFM contractions and may be useful for PFMT.