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The relationship of abnormal anorectal angle with urinary incontinence in women asymptomatic for fecal incontinence

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ABSTRACT

Objectives: The objective of this study was to explore whether alterations in the anorectal angle (ARA) manifest in women without defecation problems but encompassing different types of urinary incontinence.

Materials and Methods: Data from prospectively collected database of women with pelvic floor complaints who underwent complete urogynecological and anal examination in a tertiary reference hospital were retrospectively reviewed. Women with anal incontinence and other defecation problems were excluded from analysis. Women with a clinical diagnosis of incontinence were grouped into 3 as: Stress incontinence group, urge incontinence group, and mixed incontinence group.

Results: Pairwise comparison yielded that there was no difference in ARA between control, urge urinary incontinence, and stress urinary incontinence group (106.78±14.50, 112.08±11.56, and 113.10±6.80, respectively). However, Bonferroni comparison revealed that ARA in the mixed incontinence group (118.05±11.49) was significantly greater than ARA in the control group.

Conclusion: Women with mixed incontinence exhibits markedly elevated ARA values when compared to the continent women. These findings suggest that the co-occurrence of stress and urge incontinence is associated with deviations in anorectal anatomy, even among women who do not display symptoms of defecation problems or fecal incontinence.

Keywords: Anorectal angle; fecal incontinence; perineal ultrasonography; urinary incontinence

INTRODUCTION

All components of the pelvic floor work in a harmonious manner, with each component contributing its unique influence to pelvic symptoms, as pointed out by the integral theory (IT) of the pelvic floor.[1] In 1990, this theory revolutionized our understanding of urinary incontinence by proposing that stress incontinence and urgency stem from vaginal laxity and the weakening of supportive ligaments-specifically, the pubourethral and uterosacral ligaments. This explanation marked a pivotal milestone, particularly in the context of midurethral sling

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procedures. Over time, the IT's scope has extended, recognizing that while these two ligaments are integral, they are not the exclusive contributors to idiopathic fecal incontinence.[2]

The mechanism of anal continence is intricate and relies on the harmonious functioning of various components, including innervation, sphincter function (both internal and external anal sphincters), rectal distensibility, the anorectal angle (ARA), intestinal motility, and fecal consistency.[3] However, amidst this intricate web of influences, an active muscular mechanism for anorectal opening and closure emerges as a central protagonist.[3,4]

During straining, the puborectalis muscle, which a part of a triple loop system contracts, effectively occluding the anal canal. In contrast, during defecation, relaxation of the puborectalis coincides with the contraction of the levator plate. This action lifts the "suspensory sling" opening of the anorectal canal and facilitating evacuation simultaneously with "rectal detrusor contraction".[5]

The anorectal angle (ARA) defines the angle demarcating the connection between the rectum and the anal canal. The puborectalis muscle, a vital component of the levator ani, fashions the ARA into a supportive structure, creating a soft posterior impression that outlines the anorectal junction.[6,7] During defecation, the ARA widens, promoting efficient feces evacuation while maintaining pelvic floor integrity. Once defecation concludes, the puborectalis resumes its contracted state, restoring the acute ARA angle. This prompts the anal canal to close, returning the ARA to its original configuration and the pelvic floor to a state of equilibrium. Consequently, the ARA and sphincter relaxation are intimately connected, with the ARA's expansion facilitating voluntary defecation.[7]

Due to the close connection among pelvic floor muscles and the connective tissue, an ongoing debate has emerged concerning the potential link between anorectal and urinary dysfunction. Earlier research primarily focused on individuals with anal incontinence. Therefore, an imperative research objective has arised to examine women without anal incontinence, with a focus on the comprehensive integrity of the pelvic floor compartments. Thus, our aim was to explore whether alterations in the ARA manifest in women without defecation problems but encompassing different types of urinary incontinence.

MATERIALS AND METHODS

Data from prospectively collected database of women with pelvic floor complaints who underwent complete urogynecological and anal examination in a tertiary reference university hospital were retrospectively reviewed. Women with anal incontinence and other defecation problems were excluded from analysis. Women with a clinical diagnosis of incontinence were grouped into 3 as: Stress incontinence group, urge incontinence group, and mixed incontinence group. Control group was composed of healthy women who underwent a similar examination.

All patients underwent a pelvic floor sonography as defined by Santoro et al.[8] To evaluate the ARA, the convex probe was positioned transperineally, allowing visualization of the anorectal canal, anorectal junction, and rectal ampulla. The ARA was quantified along the midsagittal plane, defined as the angle between the rear edge of the distal rectum and the central axis of the anal canal.

Statistical Analysis

Mean and standard deviation values are used to present quantitative variables. The normal distribution of quantitative data was assessed using the Shapiro-Wilk test, and for independent samples, Student's t-test was employed. Multivariate regression analysis was used to control for possible confounding effect of age and therefor age-adjusted means for ARA measurements were calculated. $P<0.05$ was considered statistically significant.

RESULTS

One hundred and ninety-nine women underwent transperineal ultrasonography and detailed pelvic examination. According to their incontinence status patients were classified in to 4 mutually exclusive groups as: No incontinence (Control group), pure stress urinary incontinence (SUI), pure urge urinary incontinence (UUI) and mixed UI. Baseline characteristics of the patients according to incontinence status are depicted in Table 1. All four groups were similar with respect to age, body mass index, gravida and number of vaginal delivery.

Anorectal angle at rest was compared among 4 types of incontinence groups with ANOVA. Bonferroni method for pairwise comparison showed no difference in ARA between control, UUI, and SUI group (106.78±14.50, 112.08±11.56, and 113.10±6.80, respectively). However, ARA in the mixed incontinence group (118.05±11.49) was significantly greater than ARA in the control group (Figure 1).

We further analyzed age-adjusted difference in the measurement of the ARA at rest between 4 groups. This analyzed showed that the ARA difference between mixed incontinence and control group was independent of age and age adjusted difference between these groups were 11.3 (Table 2).

DISCUSSION

The relationship between anorectal dysfunction and other urinary symptoms has been a subject of debate for a long

time.[9] Most of the studies focused on patients with anal incontinence and ignored the majority of the population who are asymptomatic for anal dysfunction. In order to explore the possible anatomical abnormalities in women without defecation problems we evaluated ARA among 4 groups according to their urinary incontinence status: Control group, women with UUI, women with SUI, and women with UUI. We documented that although women with SUI or UUI tend to have an abnormally obtuse ARA, the mixed incontinence group had significantly higher ARA compared to the control group. These results indicate that combination of stress and urge incontinence associate with abnormalities in anorectal angle even in women asymptomatic for defecation problems.

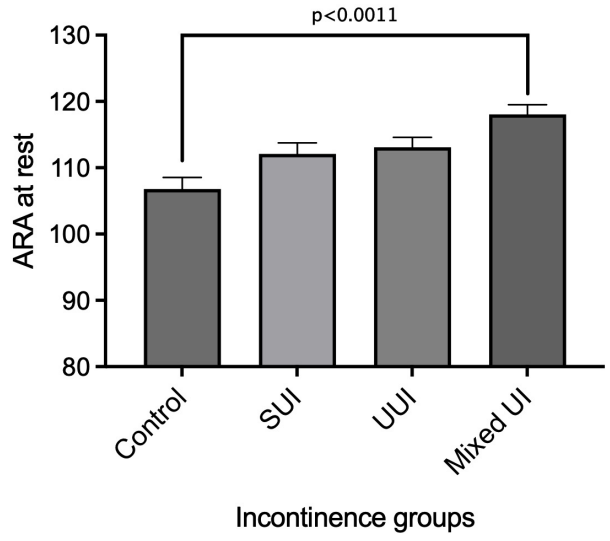

Figure 1. Anorectal angles among 4 groups of incontinence
ARA: anorectal angle; SUI: stress urinary incontinence; UUI: urge urinary incontinence

Our understanding of the mechanisms behind fecal continence and defecation is limited. The former valvular theories claimed that anterior anorectal wall of the rectum is forced by increased intra-abdominal pressure, thereby sealing the anorectal junction.[10] These theories are not currently valid because clinical studies and radiological findings suggested pelvic floor muscles take active role during continence and defecation.[5] Current explanations for normal anorectal function suggest active muscular mechanisms for anorectal opening and closure.[11] Petros[2] documented that miduretral sling procedure for stress incontinence simultaneously cure idiopathic fecal incontinence. This result intrudingly suggested that only connective tissue repair could cure fecal incontinence indicating that connective tissues should also play a role in anorectal physiology. This finding paved the way for the development of an even more comprehensive theory - "The Musculo-Elastic Theory". According to this theory, Petros and Swash[12] suggested that co-ordinated muscle forces act against durable suspensory ligaments in order to open or close the anorectal canal.

The anal continence mechanisms depend on the integral harmony of different components including neuronal innervation, muscles and ligaments. As a result of this coordination the ARA changes in defecation. The normal ARA values were defined to range from 94 to 114 degrees while at rest. This angle can vary between 15 and 20 degrees during relaxation, squeezing, or defecation.[13] Although the normal values for ARA are still debatable, abnormal ARA is related with development of fecal incontinence and other defecation problems.[14] ARA is also associated with obstetric trauma. García-Mejido et al.[15] documented that levator ani avulsion resulted in increase in the ARA during rest, contraction, and valsalva, which was more pronounced in bilateral avulsion. Another study investigating the clinical importance of ARA before sacral

Table 1. Baseline characteristics of the study population

	Control	UUI	SUI	Mixed UI	*p*-value
Age	48.97±12.07	48.24±15.84	49.15±10.19	49.92±10.69	0.940
BMI	27.30±4.16	29.23±4.51	29.19±3.90	28.40±5.05	0.142
Gravida	2.84±1.29	2.62±1.96	3.04±1.35	3.00±1.75	0.693
Vaginal delivery	2.17±1.24	1.76±1.51	2.19±1.45	2.18±1.09	0.573

BMI: body mass index; SUI: stress urinary incontinence; UUI: urge urinary incontinence

Table 2. The ARA in 4 different groups after adjustment for age

	Control group	UUI group		SUI group		Mixed incontinence group	
	Age-adjusted mean	Mean difference from control	Adjusted *p*-value	Mean difference from control	Adjusted *p*-value	Mean difference from control	Adjusted *p*-value
ARA at rest	106.78	6.29	0.250	5.31	0.138	11.29	<0.001

SUI: stress urinary incontinence; UUI: urge urinary incontinence; ARA: anorectal angle

nerve stimulation for idiopathic fecal incontinence showed that the sole independent predictor of a favorable outcome was the presence of a wide anorectal angle at rest in the preoperative defecography.[16]

According to IT, not only urinary incontinence but also other problems such as fecal incontinence and abnormal defecation are mainly caused by connective tissue laxity in the pelvic floor.[17] Our findings are consistent with the predictions of the IT. We documented in this study that mixed incontinence that is related to lax connective tissue of the uretral and vaginal surrounding is related with increase in ARA when compared to control group. To our knowledge, this is the first study in the literature comparing ARA in incontinence subgroups.

The pictorial diagnostic algorithm that is extrapolated from IT, points out the location of defects in the connective tissue. According to this algorithm faecal incontinence is estimated to be more frequent with stress incontinence in anterior zone defects and with urgency in middle zone defects.[12] The basis of this algorithm stands similar with our findings in a way that asymptomatic defects can also be observed together. Another interesting finding in our study is that the impairment in ARA becomes more pronounced when stress and urge incontinence coexist. One limitation of this study is its cross-sectional nature. Prospective follow-up of the patients is needed to define exact clinical value of asymptomatic impairment of ARA in women with mixed incontinence. Another future research goal would be to assess the changes in ARA after surgical treatment for mixed incontinence.

CONCLUSION

Women with mixed incontinence exhibits markedly elevated ARA values when compared to the continent women. This finding suggests that the co-occurrence of stress and urge incontinence is associated with deviations in anorectal anatomy, even among women who do not display symptoms of defecation problems or fecal incontinence. Prospective studies are needed to define the clinical fate of this situation in women with and without surgical management.

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ETHICS

Ethics Committee Approval: The study was approved by the Ethics Committee of Pamukkale University- 15.08.2023/13.

Informed Consent: Retrospective study.

Peer-review: Externally peer-reviewed.

Contributions

Surgical and Medical Practices: U.Ö., D.K.; Concept: U.Ö., D.K.; Design: U.Ö., D.K.; Data Collection or Processing: U.Ö., D.K.; Analysis or Interpretation: U.Ö., D.K.; Literature Search: U.Ö.; Writing: U.Ö., D.K.

DISCLOSURES

Conflict of Interest: No conflict of interest was declared by the authors.

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