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Vaginal Configuration on MRI after Abdominal Sacrocolpopexy and Sacrospinous Ligament Suspension

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Abstract: An MRI study was conducted to compare the vaginal configuration of women who had undergone sacrospinous fixation with transvaginal needle suspension or abdominal sacrocolpopexy with retropubic colposuspension with that of normal controls. MRI examination demonstrated that in normal controls the lower vagina formed an acute angle (mean 53°) with the pubococcygeal line and intersected the upper vagina at a mean angle of 145°. In the abdominal repair group the lower vagina intersected the pubococcygeal line at a mean angle of 57° and joined the upper segment at a mean angle of 137°. In the vaginal repair group the lower vagina intersected the pubococcygeal line at a mean angle of 54° and joined the upper segment at a mean angle of 220°. Our study demonstrated that abdominal sacrocolpopexy with retropubic colposuspension more closely restored the vagina to its normal configuration, whereas sacrospinous fixation with transvaginal needle suspension creates an abnormal vaginal axis.

Keywords: MRI; Vaginal vault suspension

Introduction

The optimal surgical management of women with severe vaginal vault prolapse and coexisting stress incontinence is controversial. Both vaginal and abdominal approaches have been used to suspend the prolapsed vagina and support the urethrovesical junction [1,2]. A commonly used vaginal approach consisted of sacrospinus ligament fixation with transvaginal needle suspension, whereas the standard abdominal approach involves an abdominal sacrocolpopexy with retropubic (Burch) colposuspension. Two recent studies have shown that sacrospinous ligament fixation with transvaginal needle suspension has a significantly higher recurrent prolapse and incontinence rate than abdominal sacrocolpopexy with retropubic colposuspension [1,2]. The reason for this is unknown. Studies have shown that surgical procedures that displace the vagina from its anatomic position predisposed women to develop compensatory abnormalities [3,4]. Whether abdominal sacrocolpopexy with retropubic colposuspension or sacrospinous fixation with transvaginal needle suspension distorts the normal vaginal configuration has not been previously studied. Radiological testing, specifically magnetic resonance imaging (MRI) allows comparative study of the pelvic anatomy following these procedures because of its capability for multiplanar imaging, excellent soft tissue resolution, and absence of ionizing radiation [5–7]. The purpose of this study was to compare the vaginal configuration of women who had undergone sacrospinous fixation with transvaginal needle suspension or abdominal sacrocolpopexy with retropubic colposuspension with that of normal controls using MRI.

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Materials and Methods

Six women with prolapse and incontinence and 6 controls without prolapse and incontinence were recruited for the study after IRB approval. The 6 study subjects were multiparous. All had vaginal vault prolapse beyond the hymen with Valsalva in the supine position, and coexisting stress incontinence

preoperatively. Genuine stress incontinence was diagnosed by history, physical examination, the absence of cystitis, and subtracted cystometry. Three subjects underwent sacrospinous fixation with transvaginal needle suspension as described by Raz and Muzsani [8,9], and the remaining 3 underwent abdominal sacrocolpopexy with retropubic (Burch) colposuspension, as described by Tanagho [10]. The control group was composed of 3 multiparous and 3 nulliparous women. The three multiparous controls had previously undergone total abdominal hysterectomy for symptomatic leiomyoma. After surgical correction, but prior to MRI, each woman underwent an objective evaluation that included a site-specific analysis of pelvic support. None of the subjects or controls had evidence of pelvic support defect on detailed pelvic examination at maximum Valsalva in the supine position.

After obtaining appropriate informed consent, the pelvis of all subjects and controls was imaged in the coronal, axial and sagittal planes using a 1.0 Tesla system (Picker, Cleveland, OH). For each plane of section, 7–9 images were obtained, one in the midline and the remainder symmetrically distributed on each side. The T_1-and T_2 weighted images were obtained using a standard body coil with the woman resting in the supine positioin. A second, midline sagittal image was then obtained with fast scanning (gradient echo) MRI during maximal Valsalva maneuver. On T_2-weighted images the vagina appears as a linear high signal

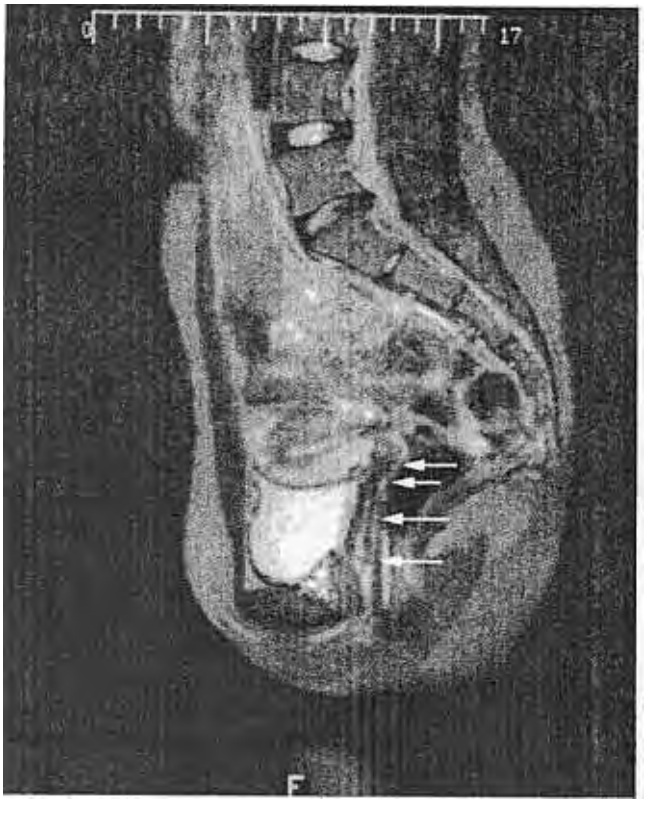

Fig. T_2-weighted sagittal image of a nulliparous control.

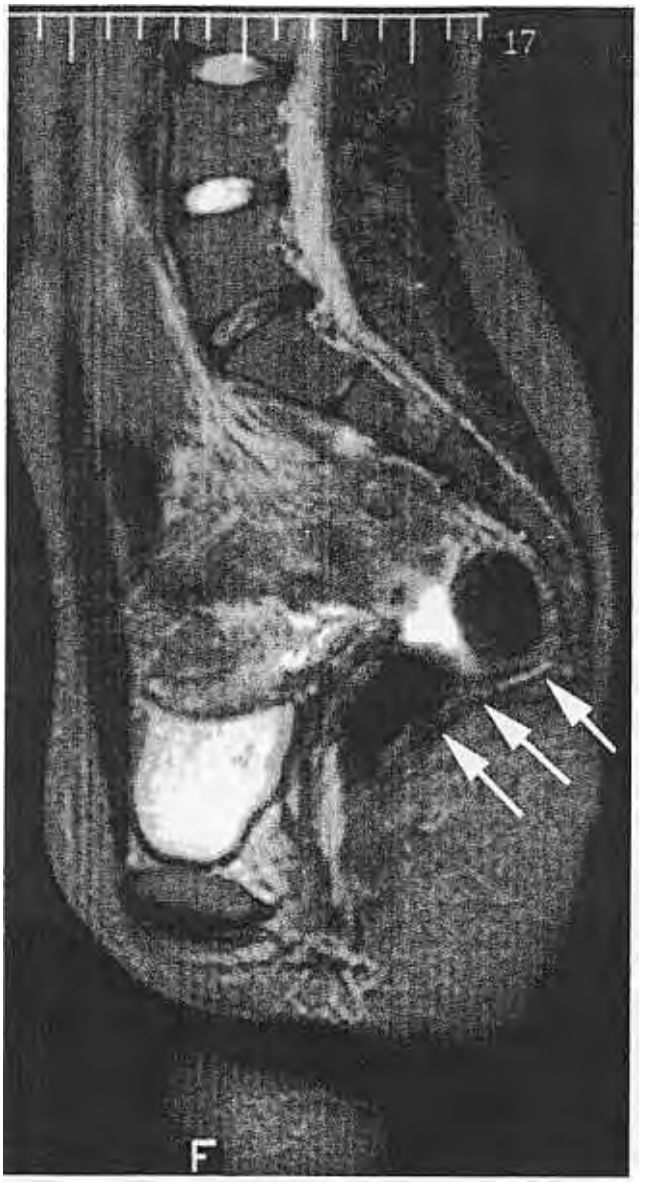

Fig. 2. T_1-weighted sagittal image demonstrating the levator plate.

intensity structure centrally representing the vaginal epithelium and mucus, and a surrounding lower-intensity wall (Fig. 1) [11,12]. Outside the wall is another high-intensity layer representing the vascular plexus. The levator plate appears as a flat, low-intensity structure between the sacrum and the anus on sagittal T_1-weighted images (Fig. 2) [11]. The angles were delineated on film by drawing a longitudinal axis through the middle of the levator plate and the upper and lower vagina on the midsagittal image, and a reference line between the inferior aspect of the symphysis pubis and the tip of the coccyx (pubococcygeal line [5]). They were then measured using a protractor. The films in the coronal, axial and sagittal planes from each woman were examined in a stepwise fashion to compare the pelvic anatomy.

Results

The nulliparous controls (mean 26.3 years, range 23–30) were younger than the rest of the women in the study (multiparous controls: mean 58 years, range 49–63;

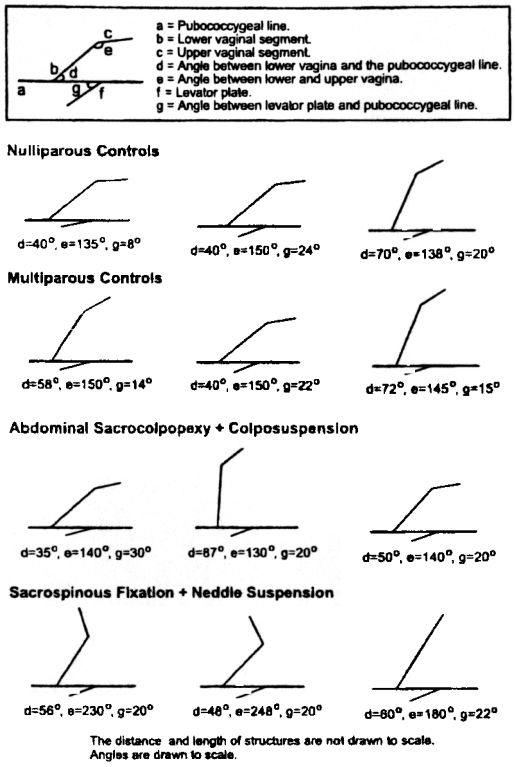

Fig. 3. Schematic representation of the vaginal configuration.

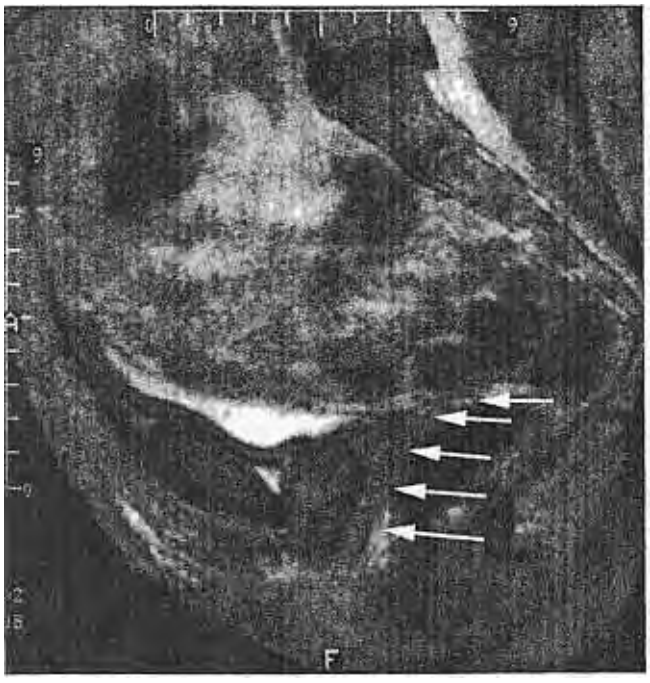

Fig. 4. T_2-weighted sagittal image of a multiparous control who had undergone total abdominal hysterectomy.

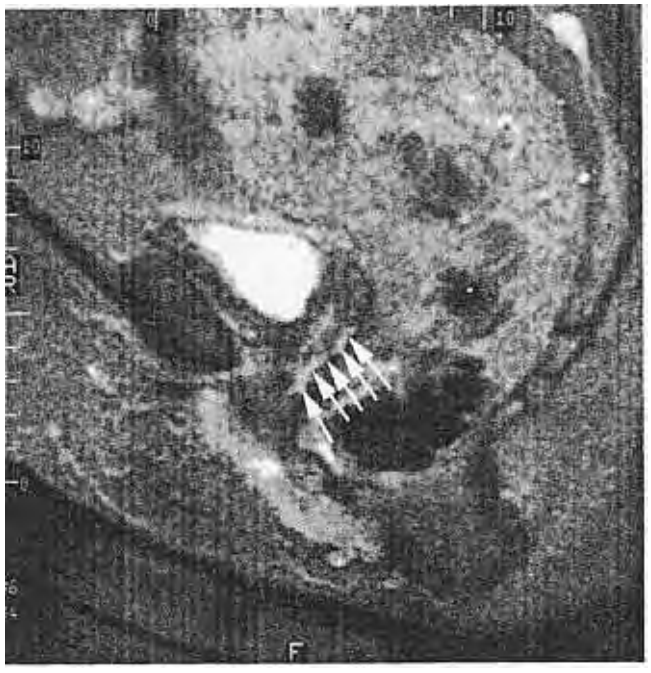

Fig. 5. T_2-weighted sagittal image of a patient who had undergone sacrospinous fixation with transvaginal needle suspension.

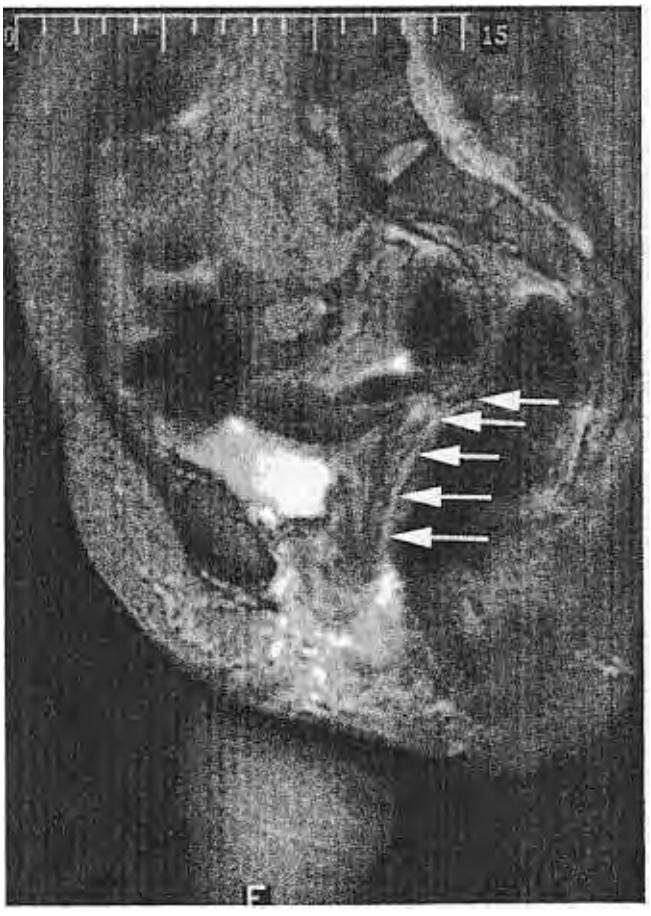

Fig. 6. T_2-weighted sagittal image of a paitent who had undergone abdominal sacrocolpopexy with retropubic colposuspension.

vaginal repair group: mean 66 years, range 59–70; abdominal repair group: mean 63 years, range 44–72). The mean parity was 2.3 (range 1–3) for the multiparous controls, 2.7 (range 2–3) for the vaginal repair group, and 3 (range 2–4) for the abdominal repair group. The measurements obtained from the MRI are depicted in Fig. 3. On the MRI pictures the vagina has an upper and a lower segment. In the control group these segments intersected at a mean angle of 145° (range 135–150). The lower vagina also formed an acute angle (mean 53°, range 40–72) with the pubococcygeal line (Figs 1 and 4). In 2 nulliparous and 2 multiparous controls the lower vagina had a slight superior convexity. In contrast, in women who had undergone sacrospinous fixation with transvaginal needle suspension the lower vagina joined the upper segment at a mean angle of 220° (range 180–248) and intersected the pubococcygeal line at a mean angle of 55° (range 48–60) (Fig. 5). In the 3 subjects who had undergone abdominal sacrocolpopexy with retropubic colposuspension, the lower vagina joined the upper segment at a mean angle of 137° (range 130–140) and intersected the pubococcygeal line at a mean angle of 57° (range 35–87) (Fig. 6). The levator plate sloped anteriorly and inferiorly from the pubococcygeal line at a mean angle of 17° (range 8–24) in nulliparous controls, 17° (14–22) in multiparous controls, 21° (20–22) in the vaginal repair group, and 23° (20–30) in the abdominal repair group (Fig. 6). We were unable to delineate the vagina clearly in any of the subjects or controls when using fast scanning (gradient echo) MRI because of decreased soft tissue contrast resolution and increased image noise (Fig. 7).

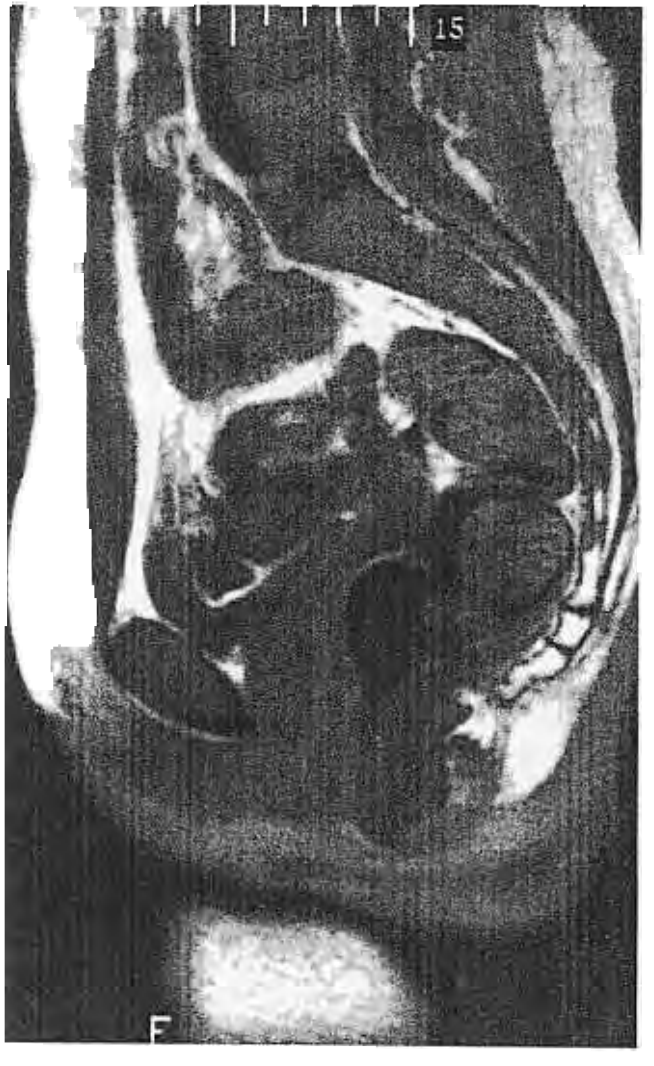

Fig. 7. Fast scanning (gradient echo) sagittal image during Valsalva.

Discussion

We have previously shown [13] that sacrospinous fixation with transvaginal needle suspension has a high recurrent prolapse and incontinence rate. The reason was believed to be the paravaginal defect created iatrogenically by transvaginal needle suspension [14]. Benson and associates [2] subsequently demonstrated that the high failure rate persisted even when this combination of procedures was performed in conjunction with a vaginal paravaginal repair. This indicates that other factor(s) may contribute to the difference in success rates between sacrospinous fixation with transvaginal needle suspension versus abdominal sacrocolpopexy with retropubic colposuspension. Studies have shown that surgical procedures that displace the vagina from its anatomic position predispose women to develop compensatory abnormalities [3,4]. This MRI study revealed that sacrospinous fixation with transvaginal needle suspension alters the vaginal configuration more than does abdominal sacrocolpopexy with retropubic colposuspension compared to normal controls. In fact, abdominal sacrocolpopexy with retropubic colposuspension closely approximates the normal vaginal configuration. We postulate that this may account for the significantly higher failure rate associated with the vaginal approach. Sacrospinous fixation with transvaginal needle suspension transforms the vagina into a posteriorly and superiorly directed, straight tubular structure that is firmly transfixed between the sacrospinous ligament, the rectus sheath and the perineal membrane. The obliquely positioned and transfixed vagina no longer lies on the levator plate or the perineal body to deflect intra-abdominal pressure increases or to support the weight of the abdominopelvic contents: it is now subject to the full extent of such forces, thus predisposing women to develop recurrent prolapse and incontinence. In contrast, abdominal sacrocolpopexy with retropubic colposuspension brings the vagina back into a normal anatomic position in the hollow of the sacrum. This allows the vagina to reposition itself over the levator plate and use these normal compensatory mechanisms to deflect intra-abdominal pressure and weight.

These findings are limited by factors common to most radiological studies. The measurements were obtained by using a previously described pubococcygeal line as a reference and a longitudinal axis drawn through the

middle of the upper and lower vagina. As each vaginal segment has a slight curvature when imaged in the sagittal plane, drawing a longitudinal axis through the center requires some subjective interpretation. In addition, the sacrum and the coccyx have different degrees of curvature in each woman, which will influence the location of the pubococcygeal line and subsequent measurements. For these reasons, it is more appropriate to look at the general position and configuration of the vagina and the levator plate rather than focusing on specific angles.

Another limitation associated with MRI study of pelvic support is that the woman must be imaged in the supine position. Previous investigators have attempted to overcome this problem by performing dynamic fast MRI while the woman is performing Valsalva [5,7]. However, fast scanning MRI results in increased anatomic distortion. We were unable to use the images generated by this technique to evaluate the full effect of gravitational pull and the standing position on the pelvic support mechanisms. We do not feel that absence of these images influences the study outcome, as previous studies have demonstrated that increases in intra-abdominal pressure only cause the upper vagina to assume a more horizontal position and do not alter the general configuration of the vagina, regardless of whether the women is in the supine or the erect position [15,16].

Two women who underwent sacrospinous fixation with transvaginal needle suspension demonstrated the upper vagina to be directed anteriorly. We believed that this is probably caused by mild descensus of the anterior vaginal wall, redundant vaginal length, or overcorrecting of the anterior wall defect by the transvaginal needle suspension.

This was a pilot study that attempted to determine why vaginal repair was associated with a significantly higher rate of recurrent prolapse and incontinence rate compared to the abdominal approach. We clearly demonstrated that sacrospinous fixation with transvaginal needle suspension, compared to abdominal sacrocolpopexy with retropubic colposuspension, creates an abnormal vaginal configuration rather than restoring the normal vaginal axis. We postulate that this compensatory restoration may cause sacrospinous fixation with transvaginal needle suspension to have a higher recurrent prolapse and incontinence rate than abdominal sacrocolpopexy with retropubic colposuspension.

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EDITORIAL COMMENT: This pilot study helps to elucidate the mechanism of recurrent prolapse in patients who have undergone sacrospinous fixation with transvaginal needle suspension (SSF and TNS). The authors use magnetic resonance imaging (MRI) to demonstrate that SSF with TNS reesult in an abnormal vaginal axis – too vertical, or even anterior (ventral) – compared to normal controls. Previus studies have shown that an abnormal vaginal axis may predispose to recurrent prolapse. Interestingly, in contrast, Benson et al. [1] concluded that the sacrocolpopexy procedure axis was more anterior than the sacrospinous fixation axis. Certainly, on clinical examination after an isolated SSF procedure, the vaginal apex appears to be much more posterior than after an abdominal sacrocolpopexy procedure. One might have expected that a TNS procedure wold pull the anterior vaginal wall more anteriorly and the SSF would pull the apex posteriorly. It is surprising that the MRIs presented did not show any evidence of the vault being pulled toward the ischial spines. Perhaps a description of the clinical

examination would have given some insight into this question, and some correlation withi MRI findings could be made. But the authors do demonstrate that the vaginal axis after abdominal sacrocolpopexy and Burch procedures is more similar to that in normals than the combination of sacrospinous fixation with transvaginal needle suspension.

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