

🏆 Best in Category Prize - Imaging

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3D-RECONSTRUCTION OF MR-VISIBLE VAGINAL MESH-IMPLANTS FOR ANTERIOR COMPARTMENT REPAIR

Hypothesis / aims of study

We aim to demonstrate the reconstruction of anterior compartment defects with magnetic resonance (MR) visible vaginal mesh implants, and measure their postsurgical location and dimension relative to the bony pelvis and important anatomical structure.

Study design, materials and methods

This is a proof of concept study from a prospective multi-center study with IRB approval evaluating women surgically treated with anterior vaginal mesh-repair using a MR-visible Fe₃O₄-polypropylene implant with six fixational arms (Seratom E PA MR, Serag Wiessner, Naila, Germany) for pelvic floor reconstruction. Written informed consent was obtained in all cases. High resolution sagittal T2-weighted sequences, transverse T1-weighted (T1w) FLASH 2D and transverse T1w FLASH 3D sequences were performed on a 1,5 T scanner in this trial to evaluate Fe₃O₄-polypropylene mesh MR-visibility and overall postsurgical pelvic anatomy three months and one year postsurgical. Full mesh course and important pelvic structures were reconstructed using the 3D Slicer® software program based on T1 and T2 MR-images (Figure 1). Mesh dimensions to determine the functional postsurgical mesh length and effective size were evaluated. Furthermore, the implanted mesh location relative to the bony pelvis (e.g. distance to pubic symphysis, obturator foramen and ischial spine) and to important neurovascular structures (pudendal and obturator nerve/vessel bundles) was measured (Figure 2). Regarding all performed measurements, the original mesh dimensions as constructed by the designers (e.g. mesh length of approximately 103 mm) were taken into consideration.

Results

Six women with symptomatic POP-Q grade III cystoceles were successfully treated with a partially absorbable MR-visible anterior vaginal mesh with sacrospinale fixation showing no adverse event or recurrent cystocele in the 3 months and the 1 year follow-up examination. The course of the mesh and its arms in the pelvis was visible on T2 and T3 MR-images and reconstructable in five 3 months MRIs (patients A-E) and 2 one year MRIs (patients A & F) which had satisfactory image quality. Measurement results regarding mesh length and distances between pudendal vessel-nerve bundles are demonstrated in table 1. Distances between the locations of the posterior arms penetrating the sacrospinous ligaments and pudendal nerve/vessel bundles vary from 3 mm to 18 mm.

Interpretation of results

The distances between implanted anterior arm and middle arm presented smaller than the designed distance (Figure 2, Panel a) and a double layering of the mesh was observable in the distal mesh part, possibly, due to the fact that in this used implant four arms (anterior and middle) are diverted outwards through the obturator foramen. Compared to the by the constructor given mesh length of 103mm, the postsurgical mesh length evaluated appears shorter with only 45-62 mm. There are variations in the implanted mesh location relative to the bony pelvis and obturator and pudendal nerve/vessel bundles. The penetration point of the sacrospinous ligaments by the posterior arms vary largely within the subjects evaluated.

Concluding message

The use of MR-visible Fe₃O₄-polypropylene meshes in combination with postsurgical 3D reconstruction of the mesh and important adjacent anatomic structures is feasible and reproducible within the same subject over time and between different patients. Inner pelvic measurements are also reproducible and suggest that this combined technique might be a useful tool to more precisely evaluate the postsurgical mesh location, possibly occurring complications and that it might be a valuable interactive feedback tool for surgeons and mesh design engineers for we could demonstrate variations of postsurgical mesh size, dimension and inner pelvic location of the identically constructed implant.

Figure 1.

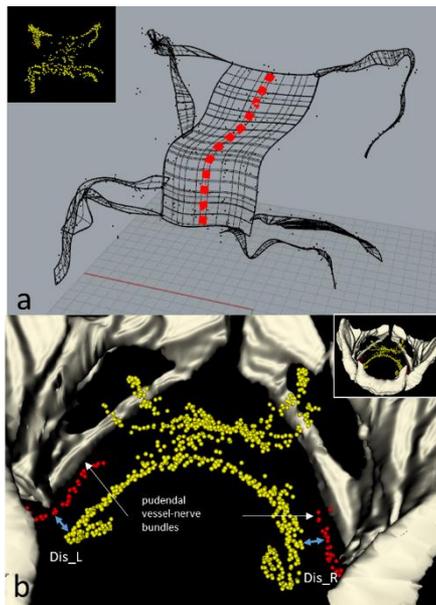
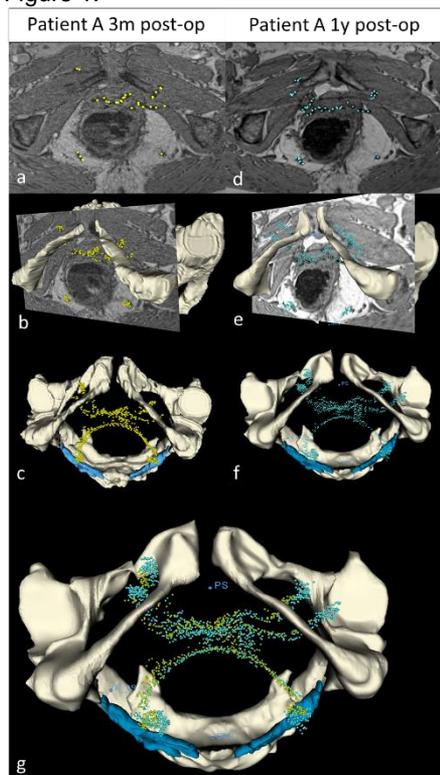


Figure 2.

Figure 1. Meshes (yellow dots in Panel a, b, c, g and blue dots in Panel d, e, f and g) were visible in the T1 MR images. The 3D models of the meshes and important anatomical structures were reconstructed at both 3 months postsurgical (Panels a, b, c) and 1 year postsurgical (Panels d, e, f). Panel g shows the superimposed mesh reconstruction at both time points by aligning the bony landmarks within one subject. The sacrospinous ligaments are marked blue (Panel c, f, g)

Figure 2. Measurement scheme. A surface was reconstructed and draped over the 3D point clouds (Panel a), the mesh length was measured (red dotted line, Panel a). The mesh (yellow dots) location relative to pudendal vessel-nerve bundles (marked with red dots and white arrows in Panel b) was measured in each patient on both sides (Dis_L /Dis_R: left/right distance of posterior mesh arm to pudendal nerve bundle, blue arrows in Panel b).

Patient	A_3m	B_3m	C_3m	D_3m	E_3m	A_1y	F_1y
Dis_L (mm)	13	6	3	11	16	5	7
Dis_R (mm)	18	3	5	5	13	13	4
Implanted mesh length	51	54	45	53	NA	62	NA

Table 1: Measurements of mesh length and its distance to pudendal vessel-nerve bundles (NA: not applicable)

Disclosures

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