MRI-visible mesh implants in patients, assessment of time-dependent configuration changes.

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TARGET AUDIENCE: Clinical Radiologists and Clinical Scientists

PURPOSE

Surgical treatment of abdominal hernia using textile implants accounts for one of the most frequent surgical procedures worldwide. Shrinkage and deformation of the implant are commonly blamed for mesh-related long-term complications (1). Purpose of this study was to evaluate mesh shrinkage and deformation over time in patients who received MRI visible mesh implants (2).

METHODS

Approved by the ethics committee, a prospective study with patients surgically treated for inguinal hernia was initiated in spring 2012. An iron-loaded mesh implant (DynaMesh visible, FEG Textiltechnik, Aachen, Germany) was placed in 13 patients using laparoscopic (n=8) or open (n=5) surgical procedures. MRI was performed at a 1.5 Tesla scanner (Achieva, Philips, The Netherlands) with a 16 channel receiver coil using gradient echo sequences (repetition time = 8.3 ms; echo time = 4.3 ms; flip angle =20°) in axial and sagittal orientation. All patients were scanned on day 1 after surgery and in two cases additionally at day 90. The remaining 11 patients are scheduled for MRI at day 90, respectively. For each time point (day 1 and 90), the susceptibility induced signal voids of the mesh were semi automatically segmented using ImageJ (National Institutes of Health; http://imagej.nih.gov/ij/) (Fig. 1) in both orientations. To avoid information loss due to mesh folding along slice orientation, both orientations were used separately to generate point clouds, which were combined using Iterative Closest Point Algorithm using dedicated software (Geomagic, Geomagic, Morrisville, USA) resulting in a polygonal surface. The centroids and areas of these surfaces (day 1 and 90) were calculated. After matching of the meshes, the movement of the centroids was assessed and the relative change of mesh configuration was visualized. The areas of the mesh surfaces were calculated. For determination of regional mesh changes, a topographic analysis was performed (Fig. 2).

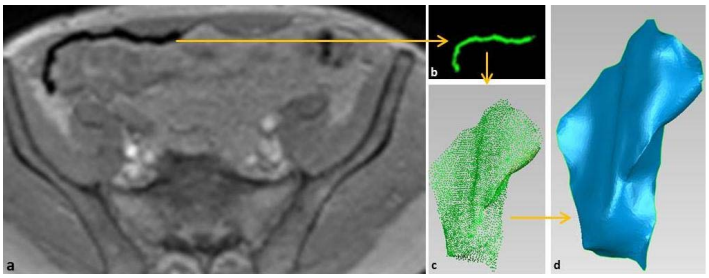

Figure 1: On the GRE images (a), the mesh implant was segmented (b) and a point cloud was generated (c), which was used to calculate a polygonal surface model (d).

RESULTS

Based on the two preliminary patients, the results of the calculations are given in Tab. 1. The topographic analysis revealed an average local change of mesh configuration of 1.4 mm for patient 1 and 1.5 mm for patient 2 with a maximum variation of 7.2 mm and 6.2 mm, respectively (Fig. 2).

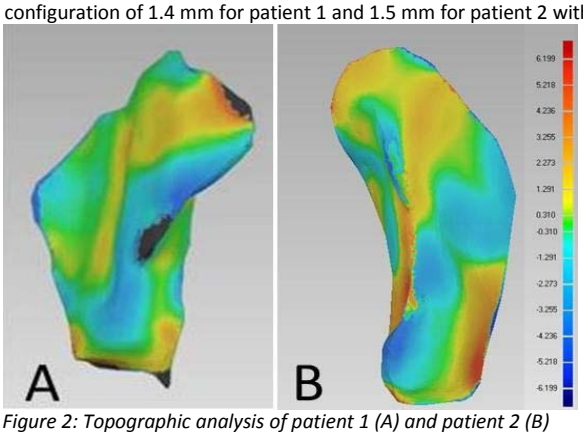

Figure 2: Topographic analysis of patient 1 (A) and patient 2 (B)

	Patient 1	Patient 2
Area day 1	257 cm²	205 cm²
Area day 90	235 cm²	183 cm²
Centroid movement	3.5 mm	6.1 mm

Table 1: Results of calculations (surface area/centroid movement)

DISCUSSION

These preliminary results show that already within the first 3 months, some mesh shrinkage but only marginal change of configuration happens. As the position of the centroid is highly depending on the mesh configuration, its movement can be taken as a sensitive indicator for mesh folding. The mild variations of up to 7.2 mm and 6.2 mm found in the topographic analysis, which gives more regional information, can be contributed to a different positioning of the patients within the scanner. By January 2013 we expect to have evaluated the other 11 additional patients who already received the mesh implant and are scheduled for MRI follow-up. Moreover, all patients are expected to be examined one year after surgery for long-term assessment.

CONCLUSION

In this study we present a new approach to determine changes of implant configuration, based on new MRI visible mesh implants. Our preliminary results indicate that only marginal mesh configuration change but some mesh shrinkage happens within the first 3 months and that the concept of long-term scar induced mesh shrinkage might have to be reconsidered.

REFERENCES

1. Burger JW et al. (2004). Long-term follow-up of a randomized controlled trial of suture versus mesh repair of incisional hernia. Ann Surg. 240:578–583.
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