MEDICAL BACKGROUND
Most patients diagnosed with a primary tumor receive local radical tumor and lymph node resection. Known disadvantages of this radical lymph node resection are missed lymph nodes during resection, over-treatment and missed metastases during histopathological analysis. A sentinel node biopsy procedure with a radioactive tracer can potentially overcome these drawbacks. This tracer however, is associated with strict rules and regulations. In this study a radiation-free magnetic alternative, Magtrace® (Endomagnetics Ltd, UK, [1]) will be used.

To detect the magnetic tracer intraoperatively a magnetic detector will be used. As of this moment only the Sentimag® (Endomagnetics Ltd, UK) magnetic detector is commercially available and CE certified for in-patient use (Figure 1). However, the Sentimag is not only sensitive to SPIONs, but also to the diamagnetic human tissue. (2) Differential Magnetometry was developed to overcome these drawbacks by detecting the specific magnetic signature of SPIONs. [3]

DIFFERENTIAL MAGNETOMETRY

FIGURE 1 Sentimag magnetic detector Endomagnetics Ltd. UK. [1]

FIGURE 2 DiffMag magnetic detector University of Twente, NL.

FIGURE 3 The concept of Differential Magnetometry simulated for monodisperse iron oxide particles with 16 nm diameter (A). The alternating excitation field is applied with intervals with a positive and negative offset field amplitude (B). The colors in each panel correspond with the offset field amplitude. Nonlinear magnetic susceptibility results in a reduced alternating magnetization response during periods with offset field (C), which is proportional to the amplitude of inductively measured signal (D). The DiffMag voltage ΔU specifically represents the contribution from magnetic nanoparticles in a sample. The amplitude of the AC field is approximately 1 mT, which is 100x smaller compared to Magnetic Particle Spectroscopy. [4]

OBJECTIVES & METHODS
The primary goal of this trial is to map normally missed high risk lymph nodes during standard laparoscopic pelvic lymph node dissection in twenty prostate or bladder tumor patients (Figure 4). The secondary goal of this study is to compare ex vivo our DiffMag detector with the Sentimag®. This research aims to increase the detection rate of tumor draining lymph nodes and prove the efficacy of the DiffMag technique.

FUTURE PERSPECTIVE
This clinical patient trial will give the physician a more complete map of the draining lymph nodes. It would be ideal for the physician to measure SPIONs in the lymph nodes real-time, not just beforehand based on a MRI-scan. To further our laparoscopic DiffMag prototype, we use the secondary goal of this research as input for the further development. Since most prostate/bladder operations are performed laparoscopically in the Netherlands, a magnetic detector for trocar is mandatory. The DiffMag technique will enable us to decrease the diameter of the probe while maintaining an acceptable detection depth (Figure 5).

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REFERENCES
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FIGURE 4 Study setup prostate/bladder trial. One day before surgery the SPIONs will be injected. One hour later a MRI-scan will be performed. Twenty/ twentyfour hours after injection the planned operation will be executed.

FIGURE 5 A novel laparoscopic probe for sentinel node biopsies. SPIONs are used as a tracer agent. Excitation and detection coils are mechanically separated to increase depth sensitivity. [5]