PURPOSE
To automatically extract data from CT scans through segmentation to build dynamic models of the nodes and their environment for a preoperative characterization and staging.

METHOD AND MATERIALS
We extract lymphnode shape and position from CT images and analyze the trend of pixel intensities in the various enhancement phases to determine tissue properties: the trend of contrast medium absorption/reflux varies according to tissue nature: this allows to differentiate between malignant and benign masses, though their HU levels are not visibly different. Knowing the trends of pixel intensities of tumoral and normal nodes in all the acquisition phases, and having the stiffness data of sample lymphnodes, we calibrate the images to quantify the elasticity/rigidity of the masses and classify them. We use lymphnode topography and calibrated data to initialize mass spring models that are inserted in a laparoscopy simulator with force feedback.

RESULTS
We segmented from abdominal MDCT scans normal and pathological nodes, observing that malignant nodes show pixel intensities 40% higher than benign ones on noncontrast images. From the morphological information and stiffness values a complete model of the nodes is built: we use a linear map between lymphnode mean HU and the interval [10-100]MPa to obtain tissue Young modulus, then we initialize models which are integrated in our laparoscopy simulator. Using the simulator and a haptic device surgeons can feel the different stiffness of the modelled nodes and stage them. Once a malignant node is identified we can highlight the region of interest in the 3D scenario and plan a possible laparoscopic or biopsy needle trajectory, with position and orientation information. This functionality can be used preoperatively or for intraoperative navigation.
CONCLUSION
Our approach appears to be feasible and in the future we will give a clinical evaluation of this new technique. To increase diagnostic accuracy, we are studying the possibility of integrating CT data with other imaging modalities and defining lymph node stiffness by acquiring tissue properties from superficial nodes (e.g. neck and axillary) and then calibrating the deep ones by comparing the intensities of CT images.

CLINICAL RELEVANCE/APPLICATION
Our dynamic 3D models of lymph nodes, which allow simulation of surgical palpation based on information from MDCT scans, may have a role in preoperative lymph node characterization and staging.

Disclosures:
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- Nothing to disclose: Davide Zerbato
- Nothing to disclose: Giulia Zamboni

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