Title
The development of an automatic tool to improve perforators detection in Angio CT in DIEAP flap breast reconstruction

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Objectives
The deep inferior epigastric artery perforator flap (DIEAP) is a widely used technique for breast reconstruction. For the operative plan with this flap a computed tomography angiography scan with contrast -AngioCT- is needed to evaluate the perforator vessels that will be responsible for flap viability, namely their location, course and caliber. This is an operator dependent, subjective and time consuming task. Radiologists and radiology technicians need to review all images to identify manually the perforators and their characteristics and issue a report and a map of these vessels to guide surgery. Through the use of pattern recognition techniques, we aim, in the future, at the development of a tool that will automatically perform the perforator identification task in the AngioCT images, reducing not only time consuming work of the team but also hoping to improve accuracy of perforators identification. In this pilot work we tested a new semi-automatic algorithm to identify the perforator vessels, and their characteristics by using the imaging team annotation as ground truth.

Material and Methods
Twenty AngioCT from patients who had a clinical indication to undergo a DIEAP flap for breast reconstruction were used after annotation by the imaging team. The subcutaneous and intramuscular regions of each perforator were extracted by means of a tracking procedure and a minimum cost path approach, respectively. Subsequently, a set of characteristics, fundamental for surgery planning, were retrieved from each perforator: the caliber; the position where the branch leaves the fascia; the subcutaneous course orientation; the intramuscular course length and tortuosity. Mean errors were calculated for each of the studied parameters.

Results
The algorithm was able to detect the course of the deep inferior epigastric artery perforators in the abdominal wall. Compared with the manual annotation by the radiologist the mean error of the extracted courses was 1.35mm for the subcutaneous portion of the vessels and 1.06mm for the intramuscular one. The caliber estimation method reached an error of 0.35± 0.27mm and the error related to the position where the branches leave the fascia was 1.4±1.39mm in height and 1.72±1.49mm in width. Additionally, we managed to recreate the medical report based on objective findings, by retrieving accurate and consistent characteristics of the extracted perforators.

Conclusion
By using this new algorithm it was possible to extract, in an objective and accurate manner, the characteristics of the DIEAP perforators, relevant for the surgery. The accuracy of segmentation of the fascia layer allowed us to map and characterize these vessels with a minimum error margin. The study will proceed in a prospective way aiming at replacing the human work with an easier and more accurate automatic detection.