Manual versus Automatic Classification of Laryngeal Lesions based on Vascular Patterns in CE+NBI Images

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Introduction

Longitudinal and perpendicular changes in the blood vessels of the vocal fold have been related to the advancement from benign to malignant laryngeal cancer stages. The combination of Contact Endoscopy (CE) and Narrow Band Imaging (NBI) provides intraoperative real-time visualization of vascular pattern in Larynx. The evaluation of these vascular patterns in CE+NBI images is a subjective process leading to differentiation difficulty and subjectivity between benign and malignant lesions. The main objective of this work is to compare multi-observer classification versus automatic classification of laryngeal lesions.

Methods

A dataset of CE+NBI was generated. Six observers including three experiences and three less-experienced Otolaryngologist visually evaluated vascular patterns in CE+NBI images and subsequently classified images into benign and malignant lesions. For the automatic classification, we used an algorithm that was already proposed in our previous work for automatic characterization of laryngeal lesions based on vascular patterns in CE+NBI images.

Results

The results of the manual classification showed that there is no objective interpretation possible leading to difficulties to visually distinguish between benign and malignant lesions. The results of the automatic classification of CE+NBI images on the other hand showed the capability of the algorithm to solve these issues.

Conclusion

The results confirm the relevance of the vascular patterns as an evaluation parameter for laryngeal lesions. Based on the observed results we believe that, the automatic approach could be a valuable tool to assist clinicians to classifying laryngeal lesions.

Automated design of patient-specific fibula cutting guides in mandibular reconstruction with fibula flaps

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Introduction

Mandibular reconstruction by autologous fibula flaps after tumor resection plays a key role in maxillofacial surgery. By means of computer-assisted surgery, a preoperative planning of the graft with multiple fibula segments can be performed. To reproduce virtually planned cutting edges and angles of the segments intraoperatively, so-called cutting guides can be used, which are usually designed manually with CAD/CAM methods. These guides makes it possible to reduce ischemia time and improve surgical outcome. Our goal is to automate planning of fibula cutting guides to improve accuracy and reduce time and cost intensive design efforts.

Methods

In cooperation with the Department of Oral and Maxillofacial Surgery at the Heidelberg University Hospital, we are developing a virtual planning system for mandibular reconstruction. After reconstruction planning, the system automatically calculates a fibula cutting guide considering the cutting edges of the planned segments. The surgeon can choose between different guide designs and interactivally adjust guide-position, add drill templates for fixation of the reconstruction plate and plan screw holes for guide-bone fixation. Finally, the guide can be produced using a 3D printer for intraoperative transfer of the planned segments.

Results

We initially tested our approach by planning the reconstruction and applying the cutting guides in three patient cases. In order to assess the accuracy, we created printed 3D models of the fibula and the according cutting guide. Then a surgeon perfomed the cutting operations in 10.30 minutes on average. After redigitizing the cutted graft segments, a mean distance of 0.55 mm ± 0.6 was achived compared to the corresponding virtual planned segments.

Conclusion

We successfully automated the process of designing patient-specific fibula cutting guides for mandibular reconstruction. However, for a comprehensive planning transfer, we are working on an automated design of mandible resection guides and a patient-specific reconstruction plate to ensure exact graft positioning.

Indocyanine green fluorescence endoscopy in endonasal transsphenoidal surgery

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Objective:

Today endoscopic assisted surgery is a standard procedure for transnasal transphenoidal surgery. Neuronavigation based on preoperative MR and CT data supports the endoscopic approach. Intraoperative identification of typical landmarks in sellar and pituitary surgery is necessary for optimal tumor removal. It´s well known that the vascularity of pituitary adenoma differs from the gland and stalk and from the surrounding vascular structures.
The aim of this preliminary clinical study is the intraoperative use of indocyanine green fluorescence endoscopy for 1. Visualization of surrounding vascular structures, 2. Investigation of vascularization of dura and tumor capsule and 3. Possible differentiation between tumor and pituitary gland.

Methods:

This clinical study was approved by the local ethics committee. 20 patients (13 males and 7 females) were included during one year suffering on non-active pituitary macroadenoma (n=13), hormone-active adenoma (n=6) and one mucocele with sellar enlargement . Enrollment was performed prospectively.
Rigid 0° and 30° endoscopes (4mm in diameter, Fa. Karl Storz) are commonly used for endoscopic surgery. For ICG-fluorescence a different endoscope (5,8mm in diameter) with a 0° telescope was used. A change between white light and ICG can be achieved with a foot switch.

Results:

With improvement of the local coagulation we reached a good good video quality in the 17 patients with high-resolution of internal carotid artery (ICA), intercavernous (ICS) and cavernous sinus (CS). Investigation of vascular structures in the sellar dura and tumor capsule were easily accessible in all 17 patients. During tumor removal a differentiation between pituitary gland and tumor based on ICG was achieved in only 3 patients (15%). In three patients pituitary stalk and chiasm was visualized with ICG after tumor removal.

Conclusion:

Indocyanine green fluorescence endoscopy after bony floor removal offers with high resolution an anatomical update of vascular structures (ICA, ICS, CS) before tumor resection.