Pedicle Screw Systems

Knowledge of the manufacturer of the previously implanted pedicle screw systems prior to revision spinal surgery may facilitate faster and safer surgery. Often, this information is unavailable because patients are referred by other centers or because of missing information in the patients' records. Recently, machine learning and computer vision have gained wider use in clinical applications. The authors propose a computer vision approach to classify posterior thoracolumbar instrumentation systems.

Methods: Lateral and anteroposterior (AP) radiographs obtained in patients undergoing posterior thoracolumbar pedicle screw implantation for any indication at the authors' institution (2015-2021) were obtained. DICOM images were cropped to include both the pedicle screws and rods. Images were labeled with the manufacturer according to the operative record. Multiple feature detection methods were tested (SURF, MESR, and Minimum Eigenvalues); however, the bag-of-visual-words technique with KAZE feature detection was ultimately used to construct a computer vision support vector machine (SVM) classifier for lateral, AP, and fused lateral and AP images. Accuracy was tested using an 80%/20% training/testing pseudorandom split over 100 iterations. Using a reader study, the authors compared the model performance with the current practice of surgeons and manufacturer representatives identifying spinal hardware by visual inspection.

Results: Among the three image types, 355 lateral, 379 AP, and 338 fused radiographs were obtained. The five pedicle screw implants included in this study were the Globus Medical Creo, Medtronic Solera, NuVasive Reline, Stryker Xia, and DePuy Expedium. When the two most common manufacturers used at the authors' institution were binarily classified (Globus Medical and Medtronic), the accuracy rates for lateral, AP, and fused images were 93.15% ± 4.06%, 88.98% ± 4.08%, and 91.08% ± 5.30%, respectively. Classification accuracy decreased by approximately 10% with each additional manufacturer added. The multilevel five-way classification accuracy rates for lateral, AP, and fused images were 64.27% ± 5.13%, 60.95% ± 5.52%, and 65.90% ± 5.14%, respectively. In the reader study, the model performed five-way classification on 100 test images with 79% accuracy in 14 seconds, compared with an average of 44% accuracy in 20 minutes for two surgeons and three manufacturer representatives.

Conclusions: The authors developed a KAZE feature detector with an SVM classifier that successfully identified posterior thoracolumbar hardware at five-level classification. The model performed more accurately and efficiently than the method currently used in clinical practice. The relative computational simplicity of this model, from input to output, may facilitate future prospective studies in the clinical setting [1)]

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Anand A, Flores AR, McDonald MF, Gadot R, Xu DS, Ropper AE. A computer vision approach to identifying the manufacturer of posterior thoracolumbar instrumentation systems. J Neurosurg Spine. 2022 Dec 27;38(4):417-424. doi: 10.3171/2022.11.SPINE221009. PMID: 36681945.