Machine Learning as a Tool in Detecting Rib Fractures in Pediatric Patients

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Background/Objective:

Rib fractures are one of the most specific fractures in child abuse and are among the most common identified, reported in up to 45% of cases. Given rib fractures can be subtle and difficult for even experienced radiologists to identify, a diagnostic tool to improve the detection accuracy would provide value in evaluation of child abuse.The objective of this investigation is to create a machine learning algorithm with the ability to recognize the presence or absence of rib fractures on chest radiographs in pediatric patients less than 3 years old.

Methods:

The IU Health radiology archive (DORIS) was searched for reports (Jan 2020-June 2022) for skeletal surveys in patients less than 3 years of age. 3 view chest radiographs (frontal and bilateral oblique) from the surveys were fit into two datasets: no rib fracture or presence of rib fracture. A machine learning model was trained and tested using the constructed datasets with Histogram of Oriented Gradients (HOG) features extracted to refine the prediction accuracy.

Results:

The study group contained 100 patients (40 females, mean age 8 months) with 299 radiographs with reported rib fractures. The gender and age-matched control group included 100 patients had 300 radiographs without reported rib fractures. The overall performance accuracy of the trained model was 95.9%. PPV, NPV, sensitivity, and specificity were 96.83%, 88.32%, 87.32%, and 97.09% respectively.

Potential Impact:

Given the demonstrated effectiveness of the machine learning model, it could serve as an aid to be used in the interpretation of skeletal surveys for child abuse. More importantly however, it may also be considered as a screening tool in identifying rib fractures in unsuspected patients, such as chest radiographs in the emergency room setting where ribs may not be the primary focus of evaluation and fractures may go overlooked.