cervicothoracic scoliosis: a comparative radiographic study

Yong Qiu[1], Saihu Mao[1], Yanyu Ma[1], Song Li[1], Yitong Zhu[1], Zhen Liu[1], Benlong Shi[1], Jun Qiao[1], and Zezhang Zhu[1]

[1]Spine Surgery, The Affiliated Drum Tower Hospital of Nanjing University Medical School, Nanjing, China

Study Design: A radiographic study. **Objective:** To figure out which risk factor drive the occurrence of proximal takeoff phenomenon (PTO) in congenital cervicothoracic scoliosis (CTS). **Summary of Background Data:** Congenital vertebral malformation in cervicothoracic region can bring about PTO which usually causes remarkable cosmetic issues including head shift, torticollis and trunk imbalance. The underlying mechanisms are currently not fully illustrated, making precise design of treatment strategy unattainable. This study aimed to identify the key deformity parameter in head-neck-shoulder complex being responsible for occurrence of PTO. **Method:** CTS patients were stratified into case and control groups according to the presence of PTO. The radiographic deformity parameters of head-neck-shoulder complex were measured and compared between the two groups involving head shift, head tilt, neck tilt, clavicle angle (CA), radiographic shoulder height (RSH) and C5-T1 tilt angle etc. The main risk factor for PTO was identified through logistic regression analysis. **Result:** 16 CTS patients with PTO were recruited, and the control group consisted of 16 matched CTS patients without PTO. The average Cobb's angle was $77.6 \pm 25.6°$ in PTO group and $57.5 \pm 21.4°$ in control group ($p < 0.05$). Significant difference could be observed for head shift, neck tilt, CA, RSH and C5-T1 tilt ($p < 0.05$) between PTO and control groups. Multiple logistic regression analysis revealed that head shift, but not head and neck tilt was significantly correlated with the occurrence of PTO ($p < 0.05$). **Conclusion:** Development and progression of head shift rather than head tilt is a significant causative factor initiating the occurrence of PTO in CTS. A fully understanding of this mechanism is beneficial for correcting this complicated and annoying congenital spinal deformity.

21

A197: Machine learning in diagnosing cervical spine injuries

Nicholas Kruger[1], Sasha Abramowitz[2], and Geoff Nitschke[2]

[1]Department of Surgery, Division of Orthopaedics
[2]Computer Science, University of Cape Town, Cape Town, South Africa

Introduction: Machine-learning algorithms (Artificial Intelligence) have demonstrated remarkable progress in image recognition tasks, especially in the medical field. In our setting, radiologist reporting on x-rays is often not available in peripheral hospitals. X-rays often need to be interpreted by junior doctors working after hours in busy emergency departments, leaving room for radiological errors. AI could prove to be the ideal diagnostic tool where swift and accurate diagnosis of cervical spine injuries are required. Machine-learning networks originally developed for other tasks can be applied to skeletal x-rays with minimal intervention. Machine-learning is increasingly being used in diagnosis and can be expected to gradually change clinical practice, assisting clinicians, and improving inter-rater reliability. We aimed to evaluate the diagnostic accuracy of AI in interpreting lateral cervical spine x-rays. **Material and Methods:** From the Groote Schuur Hospital PACS database, images from 2015-2020 were searched for patients between ages of 18-45 who had cervical spine X-rays and CT scans. 924 lateral c-spine images were exported in a standardized format and annotated on a spreadsheet with descriptors for the various conditions we wanted to include in machine learning. To interpret the X-rays, deep neural networks (DNN) were used. For each labelled condition a separate DNN was trained to predict whether that pathology was present, but not exactly where on the X-ray the pathology occurred. This allows for a human-in-the-loop style of AI, bringing doctors into the prediction process, by using the DNN prediction as a guide doctors can then diagnose the exact location of the pathology. **Results:** This dataset was unbalanced, most labels having less than 10% positive examples. The preliminary results from looking only at fracture pathology on lateral views, found 14.18% positive examples. The DNN achieved a sensitivity of 68%, specificity 84% and accuracy of 79%. In comparison, radiologists with 5 years' experience achieve sensitivity 89.6%, specificity 87.8% and accuracy of 88.5% using 3 trauma x-ray views. **Conclusion:** The preliminary results observed for the fracture pathology were promising in terms of accuracy and precision, however the recall was low. Preponderance of negative x-rays made it harder to learn the positive cases, so while positive predictions were mostly correct, it was less likely to identify true positives due to the data imbalance. Our results were based on single lateral views only, often poor quality and incomplete LODOX images and this speaks to the potential power of machine learning in assessing x-rays. We plan to improve the recall by weighting the true positives significance in the deep neural networks as well as incorporating a significantly larger unlabeled dataset for semi-supervised learning.

Global Spine Journal. 2022;12(3_suppl):4S-204S. doi:10.1177/21925682221096074