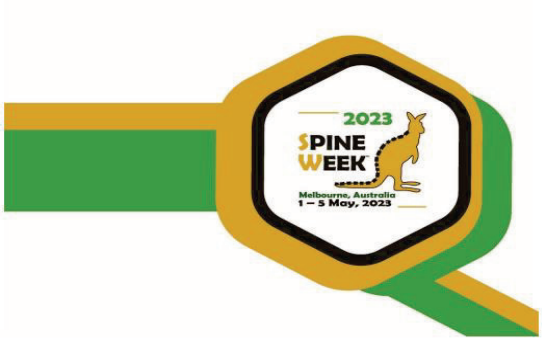

O217

Developing a new tool for scoliosis screening in a tertiary specialistic setting using artificial intelligence: A retrospective study on 10,813 patients

Negrini F.[1,2], Galbusera F.[3], Cina A.[3,4], Ferrario I.[5], Zaina F.[5], Donzelli S.[5], Negrini S.[6,7]
[1]Dept. of Biotechnology and Life Sciences, University of Insubria, 21100 Varese; [2]Istituti Clinici Scientifici Maugeri IRCCS, Varese, Italy; [3]Spine Center, Schulthess Clinic, 8008 Zürich; [4]Biomedical data science lab, Dept. of Health sciences and technology, ETH Zurich, Zurich, Switzerland; [5]ISICO (Italian Scientific Spine Institute), Milan; [6]Dept. of Biomedical, Surgical and Dental Sciences, University "La Statale", Milan; [7]IRCCS Istituto Ortopedico Galeazzi, Milan, Italy

Introduction: There is growing evidence supporting the efficacy of conservative treatment (e.g. exercises, soft and rigid bracing1) for Adolescent Idiopathic Scoliosis (AIS). As conservative treatment is more effective on skeletally immature spine, it is possible to obtain better results with early treatment 2. Thus, refined scoliosis screening can improve the care given to AIS patients. On the other hand, is important to consider that, while technological improvement has led in recent years to lower radiation dosage on x-ray examination, is not possible to nullify long-term cancer risk due to stochastic effect of radiation, even on low radiation dosage3. The aim of our study is to analyse if adding to the Angle of Trunk Rotation (ATR°) other fast and reliable clinical parameters can improve scoliosis screening.
Methods: We took into consideration 10,813 patients between 4 and 18 years old who underwent clinical and radiological evaluation for scoliosis in a tertiary clinic specialized in spinal deformities. After excluding patients who wore brace, had secondary scoliosis or did not have any hump, we analysed 7,378 cases. We considered ATR°, Hump (mm), visible asymmetry of waist, scapulae and shoulders, familiarity, sex, BMI, age, menarche (yes/no), localization of the curve. We implemented a Support Vector Machine (SVM) model to classify the Cobb angle according to different thresholds of 15, 20, 25, 30, and 40 degrees. We randomly split the dataset into 80%-20% for training and testing respectively. We used confusion matrices to evaluate the performances of the model for the different thresholds and we investigated the feature importance to understand which parameters contributed the most to model performances. Moreover, we compared the box plot of the variables between the correctly classified samples (True Positives) and the samples that should have been classified as positives, but were wrongly classified as negatives (False Negatives).
Results: The confusion matrices showed good performances in terms of accuracy using the different thresholds. In particular, the accuracies were 74%, 77%, 81%, 87%, and 93% for 15, 20-, 25-, 30- and 40-degrees thresholds respectively. As we expected increasing the threshold led to an increase in performance since a Cobb angle greater than 40 degrees is well reflected in the parameters collected and so it is easier to detect. For all the thresholds ATR°, Hump (mm), and visible asymmetry of waist were always in the top five most important variables for the prediction. The box plots showed that the samples that were wrongly classified as negatives had always statistically significant ($p<<0.01$) lower values of ATR° and Hump. This confirmed that these two parameters were very important for the correct classification of the Cobb angle. **Conclusions:** Machine-learning based classification models have the potential to effectively improve the non-invasive screening for AIS thus reducing x ray exposure to healthy young individuals. Based on the positive results of the study, we might be able to develop, in a near future, a very flexible and easy-to-use tool, to enable physicians working in specialized setting to decide whether to prescribe radiographicimaging.

References:

[1]Weinstein SL, Dolan LA, Wright JG, Dobbs MB. Effects of bracing in adolescents with idiopathic scoliosis. *N Engl J Med*. 2013;369(16):1512-1521. doi:10.1056/NEJMoa1307337
[2]Negrini S, Donzelli S, Aulisa AG, et al. 2016 SOSORT guidelines: orthopaedic and rehabilitation treatment of idiopathic scoliosis during growth. *Scoliosis Spinal Disord*. 2018;13:3. doi:10.1186/s13013-017-0145-8
[3]Simony A, Hansen EJ, Christensen SB, Carreon LY, Andersen MO. Incidence of cancer in adolescent idiopathic scoliosis patients treated 25 years previously. *Eur Spine J Off Publ Eur Spine Soc Eur Spinal Deform Soc Eur Sect Cerv Spine Res Soc*. 2016;25(10):3366-3370. doi:10.1007/s00586-016-4747-2