Using Machine Learning Techniques to Classify Vertical Facial Deformity.

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Machine learning techniques have been used to identify patterns and rules of association in many clinical datasets. The aim of this study was to compare the ability of several such techniques to give an objective classification of patients into normal, short or long vertical facial height subgroups. The study group consisted of 131 patients attending a specialist orthodontic clinic. For every patient, the values of 19 cephalometric parameters were determined from the lateral radiographs. The radiographs were also digitised for computer-based measurement. The decision-tree algorithm C5.0, in the CLEMENTINE system, was used in a supervised learning mode with two separate gold standards, each set by a different clinician. Two additional classifications were generated using Kohonen neural networks on the raw cephalometric data and a Principal Components Analysis (PCA) of shape templates made up of 148 points (19 of them cephalometric landmarks) taken from each digitised radiograph. The classifications induced by the decision trees were compared with those of the clinicians using a weighted kappa statistic derived from frequency tables. The agreement between the clinicians scored a weighted kappa of 0.71. One decision tree that emphasised MM and SNMn agreed well with one clinician (weighted kappa: 0.97) and another slightly less well with the other clinician (weighted kappa: 0.81). However, the clusterings of the Kohonen networks and PCA resulted in some ambiguities of classification and gave weighted kappas of 0.77/0.57 and 0.64/0.73 respectively when compared to the clinicians. We conclude that machine learning algorithms can perform such facial shape analysis as well as clinicians, but in the case of unsupervised learning there remains a need for subjective interpretation of the overlapping of the clusterings