**INNOVATIONS IN PEDIATRIC RETINAL DISEASE DIAGNOSIS AND UNVEILING THE GENETIC LANDSCAPE.**

**ABSTRACT:**

In children, inherited retinal diseases (IRD) can lead to severe vision problems and even blindness. Diagnosing these diseases is challenging due to numerous genetic causes and complex clinical tests, often invasive and unsuitable for young patients. To address this, a novel approach utilizing Chromatic Pupillometry, a technique assessing outer and inner retina functions, was developed. A unique Clinical Decision Support System (CDSS) based on Machine Learning and combining hardware (pupillometer) and software was created. The CDSS, employing two Support Vector Machines (SVMs) for each eye, successfully diagnosed Retinitis Pigmentosa in pediatric subjects. The system demonstrated an accuracy of 84.6%, sensitivity of 93.7%, and specificity of 78.6%. This groundbreaking study is the first to apply machine learning to pupillometric data for diagnosing genetic diseases in children. On a broader scale, a separate study aimed to understand the genetic basis of IRD, a significant cause of global blindness. Through exome sequencing of 179 Chinese families with IRD, 124 mutations in known retinal disease genes were identified, including 79 novel mutations (detection rate of 55.3%). The study revealed new genotype–phenotype correlations, highlighting the diverse genetic landscape of IRD. Notably, the identification of AHI1 as a novel candidate gene for no syndromic retinitis pigmentosa expanded the understanding of these diseases. This comprehensive exploration of genetic defects enhances our knowledge of IRD's phenotypic and genotypic heterogeneity, providing valuable insights for clinical diagnoses and personalized treatments.