Duane-radial ray syndrome

Duane-radial ray syndrome is a disorder that affects the eyes and causes abnormalities of bones in the arms and hands. This condition is characterized by a particular problem with eye movement called Duane anomaly (also known as Duane syndrome). This abnormality results from the improper development of certain nerves that control eye movement. Duane anomaly limits outward eye movement (toward the ear), and in some cases may limit inward eye movement (toward the nose). Also, as the eye moves inward, the eye opening becomes narrower and the eyeball may pull back (retract) into its socket.

Bone abnormalities in the hands include malformed or absent thumbs, an extra thumb, or a long thumb that looks like a finger. Partial or complete absence of bones in the forearm is also common. Together, these hand and arm abnormalities are known as radial ray malformations.

People with the combination of Duane anomaly and radial ray malformations may have a variety of other signs and symptoms. These features include unusually shaped ears, hearing loss, heart and kidney defects, a distinctive facial appearance, an inward- and upward-turning foot (clubfoot), and fused spinal bones (vertebrae).

The varied signs and symptoms of Duane-radial ray syndrome often overlap with features of other disorders. For example, acro-renal-ocular syndrome is characterized by Duane anomaly and other eye abnormalities, radial ray malformations, and kidney defects. Both conditions are caused by mutations in the same gene. Based on these similarities, researchers suspect that Duane-radial ray syndrome and acro-renal-ocular syndrome are part of an overlapping set of syndromes with many possible signs and symptoms. The features of Duane-radial ray syndrome are also similar to those of a condition called Holt-Oram syndrome; however, these two disorders are caused by mutations in different genes.

Frequency

Duane-radial ray syndrome is a rare condition whose prevalence is unknown. Only a few affected families have been reported worldwide.

Causes

Duane-radial ray syndrome results from mutations in the SALL4 gene. This gene is part of a group of genes called the SALL family. SALL genes provide instructions for making proteins that are involved in the formation of tissues and organs before birth. The proteins produced from these genes act as transcription factors, which means they attach (bind) to specific regions of DNA and help control the activity of particular genes.
The exact function of the SALL4 protein is unclear, although it appears to be important for the normal development of the eyes, heart, and limbs.

Mutations in the SALL4 gene prevent cells from making any functional protein from one copy of the gene. It is unclear how a reduction in the amount of the SALL4 protein leads to Duane anomaly, radial ray malformations, and the other features of Duane-radial ray syndrome and similar conditions.

**Inheritance Pattern**

This condition is inherited in an autosomal dominant pattern, which means one copy of the altered SALL4 gene in each cell is sufficient to cause the disorder. In many cases, an affected person inherits a mutation from one affected parent. Other cases result from new mutations in the gene and occur in people with no history of the disorder in their family.

**Other Names for This Condition**

- DRRS
- Okihiro syndrome

**Diagnosis & Management**

**Genetic Testing Information**

- What is genetic testing?
  /primer/testing/genetictesting
- Genetic Testing Registry: Duane-radial ray syndrome

**Research Studies from ClinicalTrials.gov**

- ClinicalTrials.gov
  https://clinicaltrials.gov/ct2/results?cond=%22Duane-radial+ray+syndrome%22

**Other Diagnosis and Management Resources**

- GeneReview: SALL4-Related Disorders
  https://www.ncbi.nlm.nih.gov/books/NBK1373
- MedlinePlus Encyclopedia: Skeletal Limb Abnormalities
  https://medlineplus.gov/ency/article/003170.htm
Additional Information & Resources

Health Information from MedlinePlus

- Encyclopedia: Skeletal Limb Abnormalities
  https://medlineplus.gov/ency/article/003170.htm

- Health Topic: Eye Movement Disorders
  https://medlineplus.gov/eyemovementdisorders.html

- Health Topic: Hand Injuries and Disorders
  https://medlineplus.gov/handinjuriesanddisorders.html

Genetic and Rare Diseases Information Center

- Duane-radial ray syndrome

Additional NIH Resources

- National Eye Institute: Low Vision

- National Human Genome Research Institute: Duane Syndrome
  https://www.genome.gov/Genetic-Disorders/Duane-Syndrome

Educational Resources

- American Society for Surgery of the Hand: Congenital Hand Differences
  http://handcare.assh.org/Anatomy/Details-Page/articleId/39392

- Boston Children's Hospital: Duane Syndrome
  http://www.childrenshospital.org/conditions-and-treatments/conditions/d/duane-syndrome

- MalaCards: duane-radial ray syndrome
  https://www.malacards.org/card/duane_radial_ray_syndrome

- Optometrists Network: Duane Syndrome
  https://www.strabismus.org/Duane_Syndrome.html

- Orphanet: Duane retraction syndrome
  https://www.orpha.net/consor/cgi-bin/OC_Exp.php?Lng=EN&Expert=233
Patient Support and Advocacy Resources

• National Organization for Rare Disorders (NORD)
  https://rarediseases.org/rare-diseases/duane-syndrome/

• Resource list from the University of Kansas Medical Center: Limb Anomalies
  http://www.kumc.edu/gec/support/limb.html

• Resource list from the University of Kansas Medical Center: Vision Impairment
  http://www.kumc.edu/gec/support/visual.html

Clinical Information from GeneReviews

• SALL4-Related Disorders
  https://www.ncbi.nlm.nih.gov/books/NBK1373

Scientific Articles on PubMed

• PubMed
  %5BTIAB%5D%29+OR+%28okihiro+syndrome%5BTIAB%5D%29+OR+%28acro-
  renal-ocular+syndrome%5BTIAB%5D%29%29+AND+english%5Bla%5D+AND
  +human%5Bmh%5D+AND+%22last+3600+days%22%5Bdp%5D

Catalog of Genes and Diseases from OMIM

• DUANE-RADIAL RAY SYNDROME
  http://omim.org/entry/607323

Sources for This Summary

• Al-Baradie R, Yamada K, St Hilaire C, Chan WM, Andrews C, McIntosh N, Nakano M, Martonyi EJ,
  Raymond WR, Okumura S, Okihiro MM, Engle EC. Duane radial ray syndrome (Okihiro syndrome)
  maps to 20q13 and results from mutations in SALL4, a new member of the SAL family. Am J Hum
  Citation on PubMed: https://www.ncbi.nlm.nih.gov/pubmed/12395297 
  Free article on PubMed Central: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC385096/

• Borozdin W, Boehm D, Leipoldt M, Wilhelm C, Reardon W, Clayton-Smith J, Becker K, Mühlendyck
  H, Winter R, Giray O, Silan F, Kohlhase J. SALL4 deletions are a common cause of Okihiro and
  acro-renal-ocular syndromes and confirm haploinsufficiency as the pathogenic mechanism. J Med
  Genet. 2004 Sep;41(9):e113.  
  Citation on PubMed: https://www.ncbi.nlm.nih.gov/pubmed/15342710 
  Free article on PubMed Central: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1735888/

  mutations in the gene SALL4 provide further evidence for acro-renal-ocular and Okihiro syndromes
  Citation on PubMed: https://www.ncbi.nlm.nih.gov/pubmed/15286162 
  Free article on PubMed Central: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1735876/
  Citation on PubMed: https://www.ncbi.nlm.nih.gov/pubmed/16086360

  Citation on PubMed: https://www.ncbi.nlm.nih.gov/pubmed/12393809

  Citation on PubMed: https://www.ncbi.nlm.nih.gov/pubmed/12843316  
  Free article on PubMed Central: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1735528/

  Citation on PubMed: https://www.ncbi.nlm.nih.gov/pubmed/20301547

  Citation on PubMed: https://www.ncbi.nlm.nih.gov/pubmed/16402211

  Citation on PubMed: https://www.ncbi.nlm.nih.gov/pubmed/16411190

Reprinted from Genetics Home Reference:  

Reviewed: December 2009  
Published: December 10, 2019

Lister Hill National Center for Biomedical Communications  
U.S. National Library of Medicine  
National Institutes of Health  
Department of Health & Human Services