# Pediatric Clinical Support:
## Waardenburg Syndrome

First described by Dutch ophthalmologist Petrus Johannes Waardenburg in 1951, Waardenburg Syndrome (WS) is caused by autosomal dominant genetic mutations that affect one out of 42,000 to 50,000 individuals. Both sexes are equally affected. Fifty-seven percent of individuals with WS will have some degree of hearing loss, the most common loss being bilateral and profound. It accounts for approximately two to five percent of all congenital hearing losses. In some cases, hearing loss has not been reported although issues related to balance were present. A white (hair) forelock is also a common sign of WS, present in 45% of individuals.

**Characterized by:**
The most notable signs of WS include sensorineural hearing loss and a white forelock. See Table 1 for the 5 Major and 5 Minor symptoms of WS. Other signs include very pale blue eyes or two different colored eyes; wide set eyes (hypertelorism); low hairline; cleft lip and/or palate; scapular elevation; intestinal and spinal defects. See Table 2 for the different types of WS and how they are expressed.

***Table 1.*** Major and Minor WS characteristics. In order to be diagnosed with WS, the individual must have 2 major criteria or 1 major and 2 minor criteria.

| 5 Major | 5 Minor |
|---|---|
| SNHL | Skin hypopigmentation |
| Iris pigmentary abnormality | Medial eyebrow flare |
| Hair hypopigmentation | Broad nasal root |
| Distopia canthorum | Hypoplasia on each side of nostrils |
| 1st degree relative with WS | Premature graying of hair |

**Audiological Treatment and Rehabilitation:**
Hearing evaluations can determine severity of loss and whether the loss is unilateral or bilateral. Appropriate amplification or cochlear implantation can be chosen based off of the individual's audiogram. Assistive listening devices can be used in addition to or in conjunction with amplification and/or cochlear implants. American Sign Language can be used as a communication method.

**Differential Diagnosis:**
Craniofacial-deafness-hand syndrome; other WS types; genetic testing to determine WS type.

**Treatment and Management:**
Although there is no cure for WS, treatments and therapies are available to alleviate certain symptoms (i.e., using hair dye to color white forelock or using laxatives if constipated). For hearing loss, amplification is recommended where appropriate, and use of FM when in a complex listening environment where the signal-to-noise ratio can be improved.

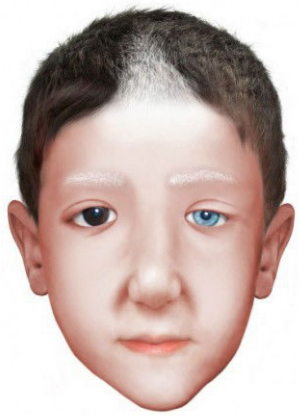

*Image courtesy of Datagenno.com*

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**Gene expression in WS and associated symptoms.** There are 4 types of WS, with a number of subtypes. Types I and II are the most common, whereas types III and IV are the least common. Although WS is primarily autosomal dominant in nature, there have been cases reported in the literature in Types II and IV that were autosomal recessive. Genetic testing is not typically done on the WS individual but on family members, for genetic counseling purposes.

**Autosomal Dominant**

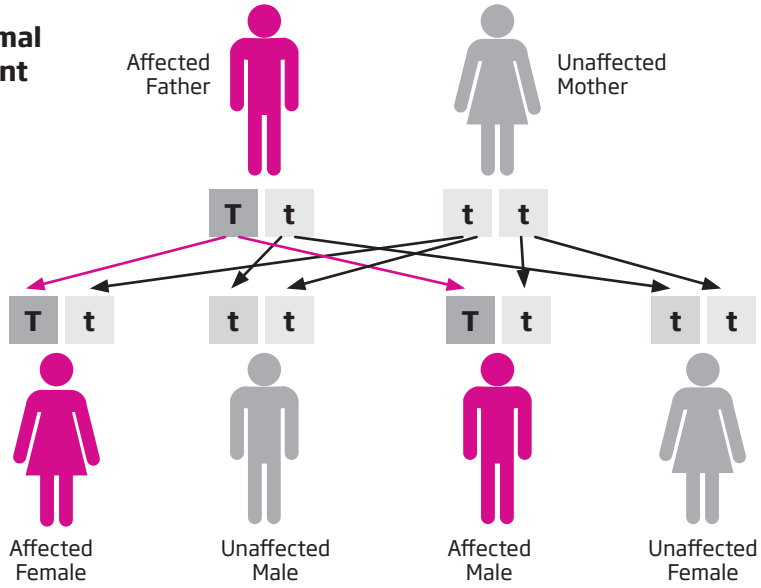


*Table 2*

| Type I | Type II | Type III | Type IV |
|---|---|---|---|
| SNHL seen in 20% of individuals, the most common loss being bilateral and profound. | SNHL seen in about half of individuals | Similar to Type I in terms of symptoms; however, they also experience skeletal deformities | Similar to Type II in terms of symptoms, but also associated with Hirschsprung's disease, an intestinal disorder |
| Typically have increased space between their eyes | Do not have increased space between their eyes | May be born with a small head and have intellectual disabilities | May have difficulties with constipation and absorbing nutrients; bowel obstruction |
| Mutation involves *PAX3* gene | Mutation involves *MITF* and *SNAI2* genes | Mutation involves *PAX3* gene | Mutation involves the *SOX10, EDN3,* or *EDNRB* genes |

**Educational and Professional Considerations:**
If an individual with WS is diagnosed with hearing loss, it should be indicated and addressed in the child's IEP. The IEP should include access to information, effective communication strategies, and other approaches for easier communication. Quality of life considerations should be addressed, including those related to hearing loss as well as diet, with all professionals who interact with the child. These professionals may include audiologists, speech pathologists, pediatricians, gastroenterologists, dermatologists, ophthalmologists, orthopedists, physical therapists, and child social worker or psychologist.


**Online and other references:**
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**Online support sources:**
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www.deafchildren.org
www.nad.org
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http://www.cleftsmile.org
http://www.faces-cranio.org
www.datagenno.com

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