**Introduction**

Down syndrome is the leading genetic cause of intellectual disability, affecting 1 in 700 live births in the United States. The disorder results in a wide range of cognitive challenges and delays in developmental milestones.

**Brain and Neurodevelopmental Alterations**

- Brain development is affected leading to processing and retention deficits.
- Neuronal growth, connectivity, and function are impaired contributing to intellectual disabilities.

**Current Therapy to Enhance Neurodevelopment**

- Speech-language and occupational therapy help improve early cognitive and language skills.
- Therapies include picture exchange, sign language, communication boards, and cognitive games to enhance learning, memory, and communication.

**Inhibiting the DYRK1A gene via EGCG to Restore Cognitive Function**

EGCG is an optimal inhibitor because it has a high specificity for the gene involved in Down syndrome and their normally developing peers.

**Towards a Cure: XIST and ZFN Technology**

- A mechanism for chromosome inactivation already exists in nature to balance gene dosage of the X-chromosome between females (XX) and males (XY) → X-inactivation.

**Conclusions and Future Directions**

- Current therapies foster neurodevelopmental progress but do not target the genetic cause.
- Targeted inhibition of the DYRK1A gene has emerged as a promising strategy to enhance cognition.
- CRISPR-Cas9 gene editing could remove the DSCR, eliminating the genes involved in cognitive deficits.
- The revolutionary goal is to harness XIST technology to silence the extra chromosome and prevent the overexpression of its genes.

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