

Pluripotent Stem Cell Therapy is a Promising Treatment for Inner Hair Cell Regeneration



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ABSTRACT

Sensorineural hearing loss (SNHL) is a condition where the inner ear hair cells, which reside in the inner ear, become damaged and are unable to self-regenerate or repair. SNHL is responsible for 90 percent of hearing loss in adults and is usually a permanent form of deafness. Pluripotent stem cell (PSC) regeneration is the process of using stem cells to regenerate damaged parts of the body. Thus, there is potential to regenerate damaged or dead hair cells with the use of PSC to recover hearing function. However, the process of regenerating hair cells through PSC regeneration remains unknown. Here, I sought to find the best approach based on prior literature for PSC regeneration on inner ear hair cells. In this review I consider the prior approaches/experiments of stem cell regeneration to determine the plausibility of regenerating hair cells with PSC. I discovered there are advantages in using PSC to regenerate hair cells, for example PSC can differentiate in vitro, in vivo, and can be derived from somatic cells. In addition, somatic cells can be used to replicate the PSC's in vitro. However, some disadvantages to this process also exist, such as the potential for cancer formation and tissue rejection. Regardless, this review argues that PSC therapy is a promising treatment for the regeneration of inner ear hair cells. Further research on how PSC can be used to regenerate hair cells may produce promising results for treating SNHL, as well as helping to understand regenerative therapies. Ultimately, there is great potential for PSC to be a viable option for the regeneration of hair cells as a treatment for deafness.

METHODS

- Extensive research of literary papers was conducted to complete this study.
- 30 different sources were used to establish consensus that pluripotent stem cell regeneration is a promising treatment method for sensory neural hearing loss

LIMITATIONS

- Cells are complex in their development and rely on many different genes to be created
- The reprogramming techniques used can cause health risks like tumor related factors, increased risk of tumorigenesis, etc.
- There is also the concern of tissue rejection following implantation
- These limitations are important to understand and recognize to be able to improve future research for the patients, for ethical purposes and for further understanding this process of regeneration.

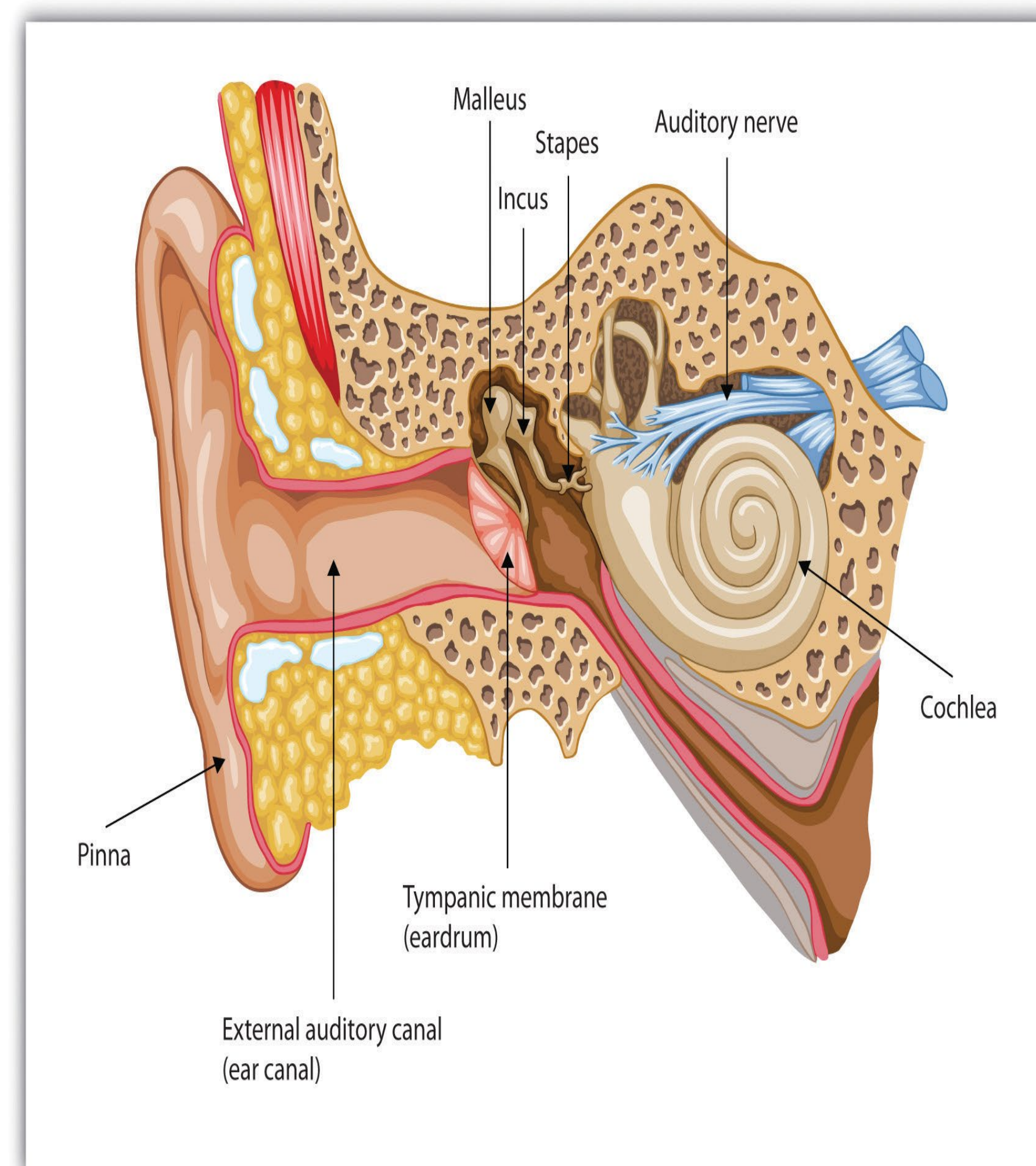


Figure 1. Diagram of the inner ear that shows where the cochlea resides.

Stangor, C. (2014, October 17). *5.3 Hearing*. Pressbooks. <https://opentextbc.ca/introductiontopsychology/chapter/4-3-hearing/>



Figure 4. 90% of hearing loss in adults is due to sensory neural hearing loss (damage of the structure to the inner ear or auditory nerve). SNHL can be caused by exposure to loud sounds, aging, head trauma, infection, genetic disposition, as well as other medical conditions. SNHL can be treated with hearing aids or a cochlear implant to compensate for the loss of hearing



Figure 5. The process of stem cell therapy would inject the stem cells into the patient to then have their damaged cells regenerated.

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Figure 6. It has been discovered how to replicate pluripotent stem cell in lab as well as in organism.

[in vitro - Image Search Results \(yahoo.com\)](https://www.gettyimages.com/detail/illustration/394924-image-search-results)

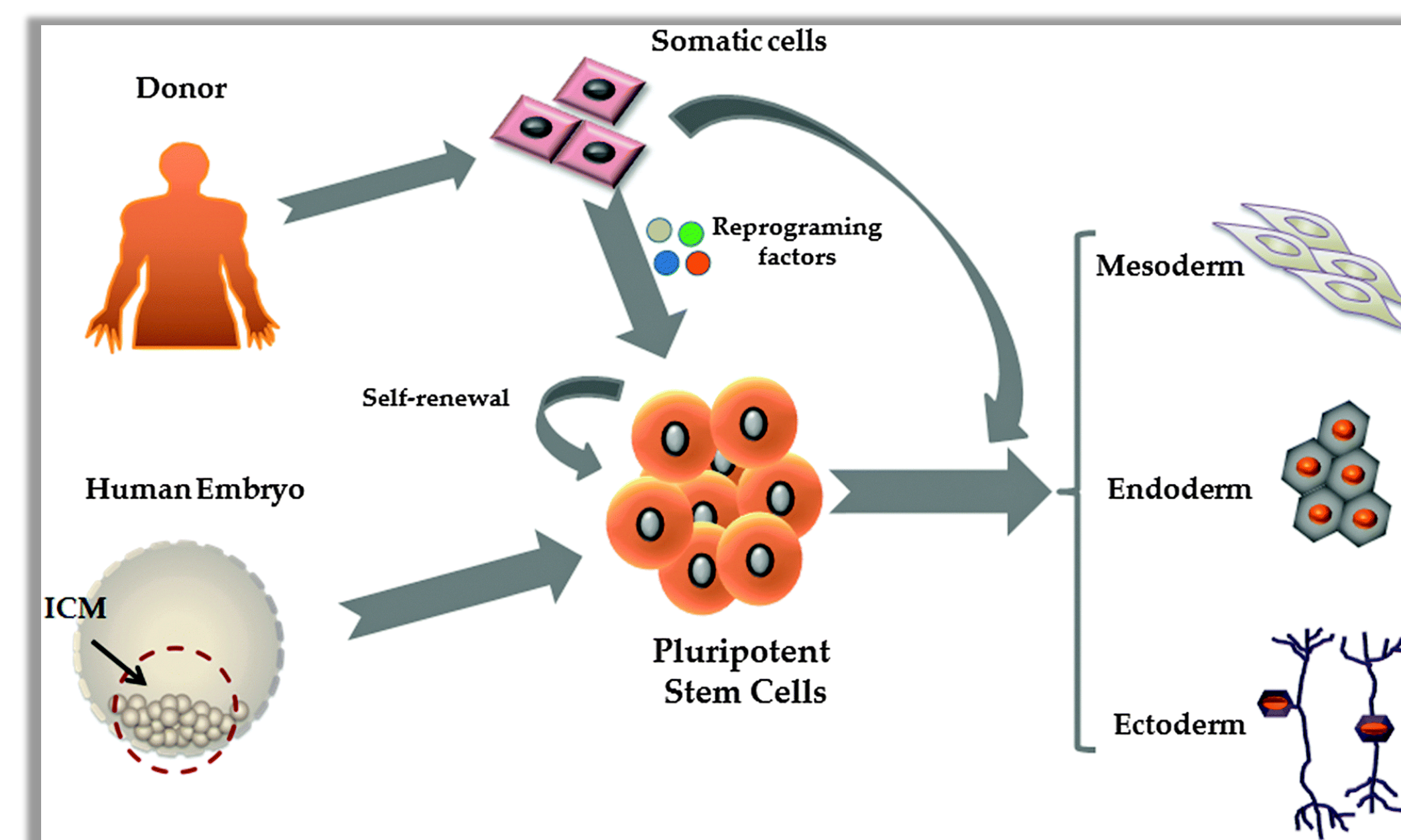


Figure 2. Diagram that shows what pluripotent stem cells are derived from as well as what pluripotent stem cells can become.

Lucendo-Villarin, B., Rashidi, H., Cameron, K., & Hay, D. C. (2016). Pluripotent stem cell derived hepatocytes: using materials to define cellular differentiation and tissue engineering. *Journal of Materials Chemistry B*, 4(20), 3433–3442.

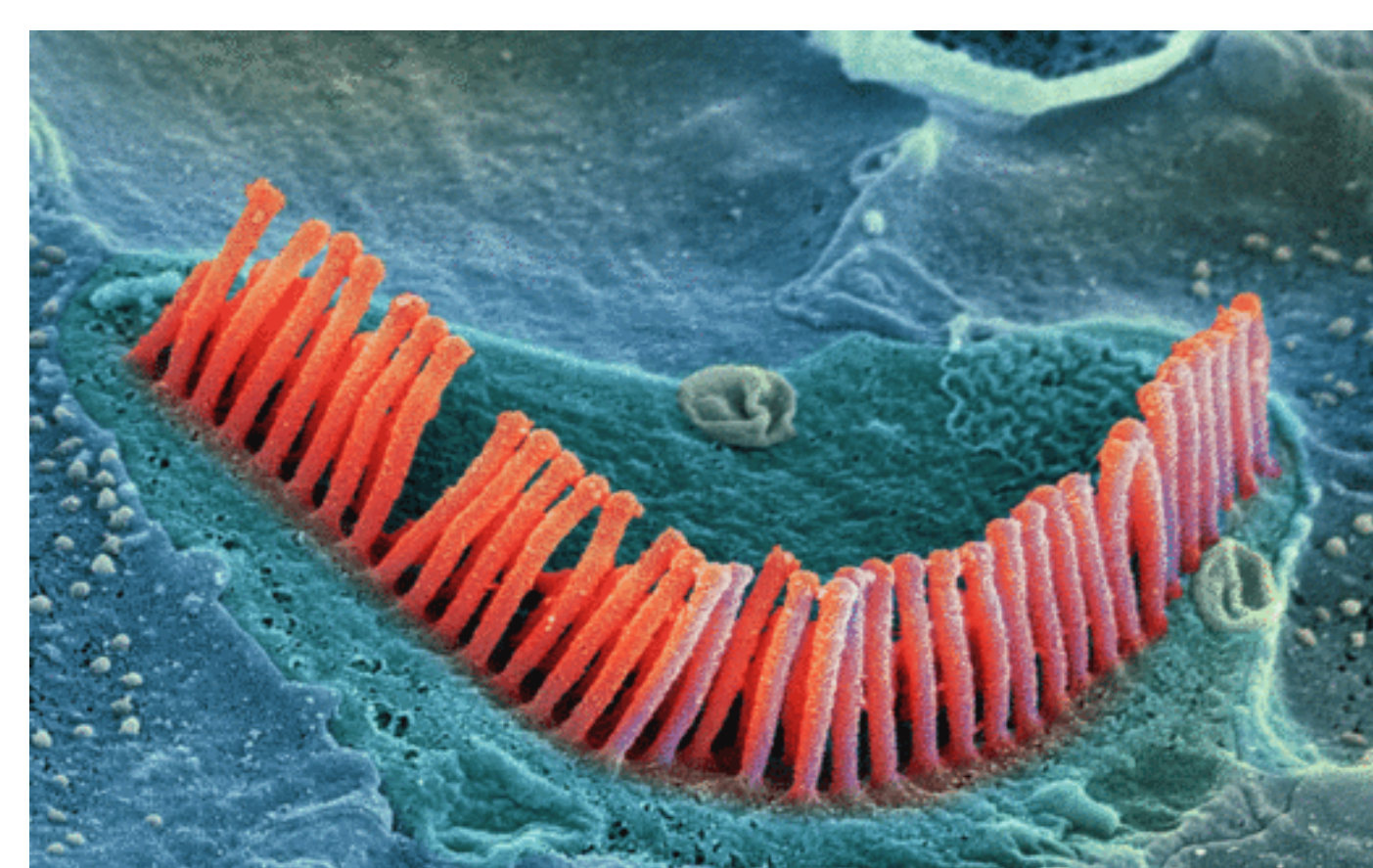


Figure 3. Shows hair cells of the inner ear. Cells are complex in their development and rely on many different genes to be created. In addition, there is also the influence of how the reprogramming

techniques used can cause health risks like tumor related factors, increased risk of tumorigenesis, etc. There is also the concern of tissue rejection following implantation.

Lobato, L. (n.d.). Artigos sobre células ciladas - Desculpe, Não Ouvi! Desculpe, Não Ouvi! <https://desculpenaouvi.com.br/tag/celulas-ciladas/>

CONCLUSIONS

- Has the potential to regenerate damaged hair cells and curing sensorineural hearing loss.
- Considering the (success in prior research for developing pluripotent stem cells in vitro)
- prior research had successfully created a proliferative supply of progenitors of the inner ear.
- More research should be conducted to fully understand how this treatment method would work i.e. how much stem cells would be needed? how many injections would be needed to fully regenerate damages? induce them into different portions of the body?
- Safe and ethical experiments and solutions should be sought to safely produce regenerated hair cells with no major side effects.

FUTURE DIRECTIONS

- Potential to produce promising results for treating SNHL and to understand regenerative therapies.
- Potential to learn more about how other stem cell can be used to cure SNHL
- How in vitro progenitors of the inner ear could be used to implement regeneration through implantation
- Conduct an experiment to implant these progenitors into the damaged hair cells and analyze the effects whether the cells undergo differentiation and or regeneration
- Test whether or not the regeneration of hair cells from progenitors is permanent or needs multiple injections.
- To understand how to make sure there is no tissue rejection from the injection of PSC

Sources

