

Best practices in cochlear implantation in prelingually deaf children who use tonal languages

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Introduction

Cochlear implants have been an effective treatment option for many individuals with hearing loss, and in the past decade, they have been introduced as a treatment option in China (Tong & Lee, 2009, p. 184). Many tonal languages are spoken in China, and those languages use a change in fundamental frequency to relay the meaning of a word (Holt, Lee, Dowell, & Vogel, 2018, p. 174). In Cantonese, there are six distinct tones, and in Mandarin, there are four distinct tones (Zhou, Huang, Chen, & Xu, 2013, p. 500). It is vital that individuals who speak these languages perceive tonal differences. Many studies have found that pediatric tonal language users with cochlear implants have significantly less accurate tonal perception and awareness compared to children of the same age range with normal hearing (Holt et al., 2018, p. 183; Tse & So, 2009, p. 77). Zhou et al. (2013) found that pediatric cochlear implant and tonal language users have worse tonal production, along with tonal perception, when compared to other children with normal hearing (p. 503). These limitations are due to the cochlear implant design, insertion technique, and postoperative aural rehabilitation methods, which limit the tonal information portrayed to the user (Tse & So, 2012, p. 77).

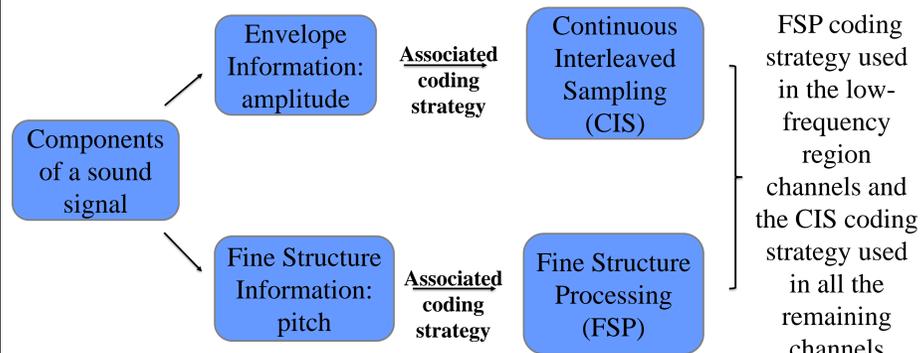
Objective

This review seeks to identify literature pertaining to the various cochlear implant designs, insertion techniques, and aural rehabilitation methods. The purpose of this review is to determine what cochlear implant design, insertion technique, and aural rehabilitation method will improve tonal perception and therefore, improve speech perception, for prelingually deaf pediatric cochlear implant and tonal language users.

Methods

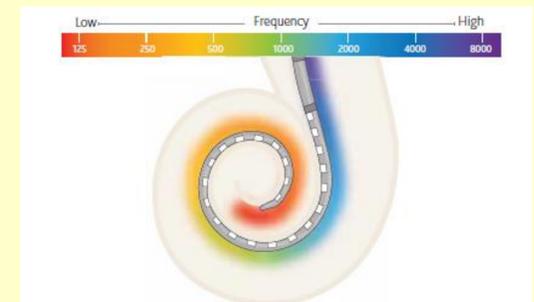
This scoping review was conducted in accordance with the guidelines prescribed by Arskey and O'Malley (2005). Seventeen relevant papers were identified. The databases used for this scoping review include ComDisDome, Medline, and Google Scholar. The search terms used for this review include cochlear implant, pediatric, prelingually deaf, tonal perception, fine structure, electrodes, coding strategy, music training, etc.

Results: Coding Strategy



(Hochmair, Hochmair, Nopp, Waller, & Jolly, 2015, p. 15; Riss et al., 2011, p. 574)

Supporting Studies:
Riss et al. (2011) found that when the pediatric patients in their study used the FSP coding strategy, their scores on the speech and sentence tests given significantly improved (p. 573). Lorens et al. (2010) also found that when the pediatric patients in their study used FSP coding strategy, they had better speech perception and preferred that strategy more (p. 1375).



(Cochlear, n.d., para. 3)

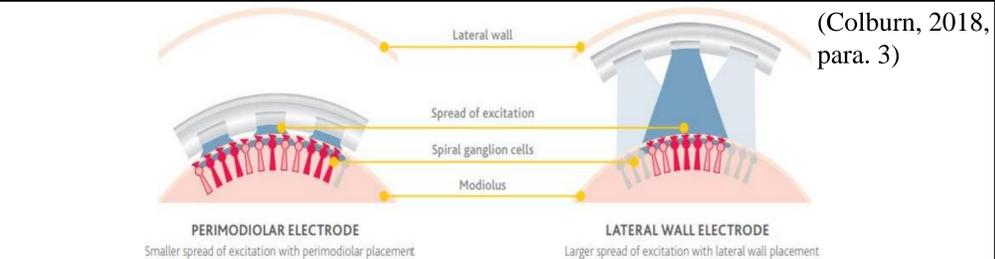
Conclusion

These findings suggest what professionals should consider when administering treatment to individuals that are pediatric cochlear implant users and speak a tonal language. It would be most beneficial for these individuals to have the Fine Structure Processing coding strategy in the low-frequency region channels and the Continuous Interleaved Sampling coding strategy in all remaining channels, so their tonal perception and speech perception can improve (Riss et al., 2011, p. 574). Also, the use of a lateral wall electrode array inserted through the round window will help these children receive the most information about pitch (Hochmair et al., 2015, p. 23). Lastly, music training will be a motivational and encouraging way for children to participate in aural rehabilitation while improving their tonal and speech perception skills (Cheng et al., 2018, p. 5). These best practices will help make individuals' tonal perception more accurate and improve their speech perception of the tonal language they speak.

Results: Electrode Array and Insertion Technique

Perimodiolar Electrode Array	Lateral Wall Electrode Array
~makes stimulations more specific	~inserted deeper
~ can traumatize medial wall	~limits trauma
~ shorter	~longer

(Mistrík, Jolly, Sieber, & Hochmair, 2017, p. 192)



The round window insertion technique is when the electrode goes through the round window instead of the side of the cochlea (O'Connell, Hunter, & Wanna, 2016, p. 171). Studies have found that inserting a lateral wall electrode through the round window and into the scala tympani allows the electrode to go to the low-frequency region of the cochlea, while limiting the trauma of the cochlea; this will optimize tonal and speech perception while preserving any residual hearing (Hochmair et al., 2015, p. 23; O'Connell et al., 2016, p. 171).

Results: Music Training

Studies	Training Description	Location	Feedback	Outcome	Retention
Cheng et al., 2018	Listened to tones and decided whether same/ different	Computer at lab	Audio and visual	Improved pitch perception	8 weeks after training
Fu, Galvin III, Wang, & Wu, 2015	Listened to tones and decided whether same/ different	Computer at home	Audio and visual	Improved pitch perception	4 weeks after training
Chen et al., 2010	Attended music classes (singing, playing instruments, etc.)	YAMAHA Music School	None	Improved pitch perception	Not assessed

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