

# Natural Progression of Hearing Loss Following Hearing Preservation Cochlear Implantation

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## ABSTRACT

### Objectives:

Determine the natural progression of hearing loss in the contralateral ear in hearing preservation cochlear implant (HPCI) surgery.

### Study Design:

Single centre retrospective review

### Methods:

Patients undergoing HPCI with devices from a single manufacturer from 2008-2013 were identified. Preoperative and postoperative pure tone thresholds at 250Hz and 500Hz were obtained for the implanted as well as contralateral ears. Patients with bilateral implants and previously non-responsive contralateral ears were excluded.

### Results:

150 patients who underwent HPCI surgery from 2008 to 2013 were identified. Of these, 83 had complete preoperative data for both ears, with an average follow up of 27 months. Mean preoperative thresholds at 250Hz and 500Hz on the operated side were 54 dB HL and 66 dB HL, which dropped postoperatively to 92 dB HL and 107 dB HL, respectively ( $p < .001$ ). Mean preoperative thresholds at 250Hz and 500Hz on the contralateral ear were 49 dB HL and 62 dB HL and 62 dB HL and 70 dB HL respectively ( $p < .001$ ). Overall, in the contralateral ear, this amounts to a 7dB drop in hearing thresholds at the tested frequencies. At 250Hz, no correlation between threshold shifts emerged between the ears ( $p = 0.07$ ,  $R^2 = 0.04$ ), whereas at 500Hz, a statistically significant correlation between threshold shifts was observed ( $p = .04$ ,  $R^2 = 0.05$ ).

### Conclusions:

Our data shows an average 7 dB drop in hearing thresholds in the contralateral ears of our patients who received HPCI surgeries from 2008-2013. This natural progression of hearing loss is important to consider when interpreting the results of HPCI surgery.

## DISCLOSURES

None

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## INTRODUCTION

Cochlear implantation has seen an expansion of candidacy criteria in recent years. Hearing preservation cochlear implantation (HPCI) has given surgeons the confidence to implant more patients with higher levels of residual hearing compared to earlier candidates with profound loss. The development of slim flexible electrodes, the use of systemic and topical corticosteroids, and minimally traumatic surgery has led to more patients being candidates for cochlear implantation. Preservation of existing hearing allows for electroacoustic stimulation (EAS) and improved audiological outcomes.

Long term follow-up data is now starting to become available for patients who have undergone HPCI, and much literature has focused on the rates of hearing preservation and threshold shifts in the operative ear over time. What is known about these patients is that the underlying disease process that caused the hearing loss can continue even after surgery. Worsening hearing in the non-operative side is a surrogate marker of this continuing process.

Our institution has a large cohort of patients with long term follow-up who have undergone unilateral HPCI using a single manufacturer's devices, standardized surgical technique, and bilateral hearing threshold measurements. Assessment of hearing threshold change in the contralateral ear can be used in the interpretation of long term results of HPCI.

## METHODS

This retrospective case series was approved by the research ethics board at our institution. The charts of patients undergoing unilateral HPCI with devices from a single manufacturer from 2008-2013 were identified.

Surgical technique was standardized across three surgeons with round window insertion, systemic and topical steroids, and slow insertion of the electrodes. Flexible electrodes of two different lengths were used (Med-EL Flex28, Med-EL Flex31). Activation of the implant was done one month postoperatively.

Charts were reviewed for patient demographics as well as preoperative and postoperative pure tone thresholds at 250Hz and 500Hz for both ears. Patients with bilateral implants and previously non-responsive contralateral ears were excluded.

Statistical analysis was performed using SPSS 21 (IBM, Armonk, NY, USA).

## RESULTS

From 2008 to 2013, 150 patients who underwent HPCI surgery with a single manufacturer's device were identified. Of these patients, 83 had complete preoperative and postoperative data for both ears.

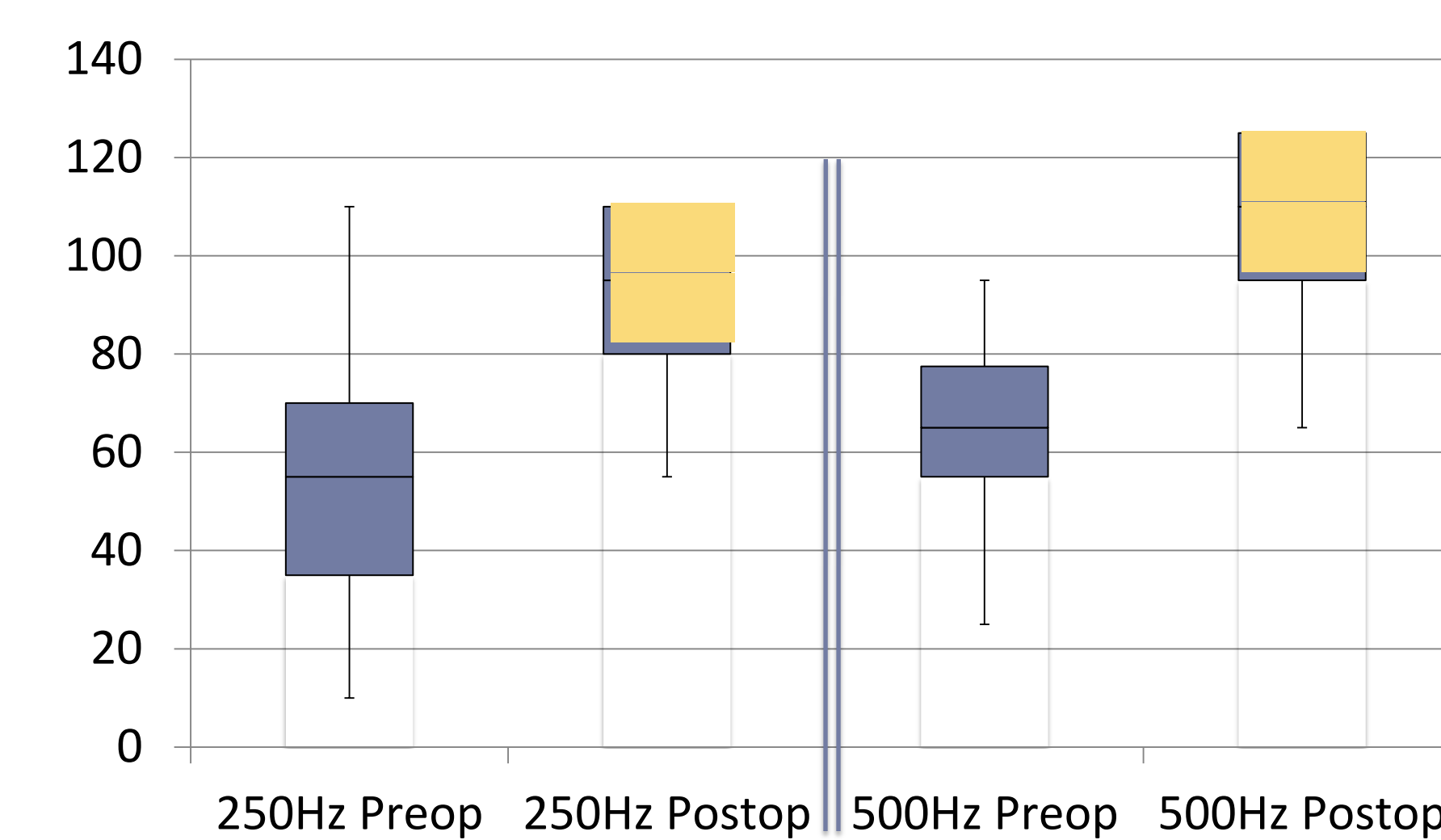
## RESULTS

**Table 1.** Patient Demographics

Demographic	Number
Patients	83
Average Age	64 (Range: 27-89)
Male	46 (55%)
Right sided implant	46 (55%)
Flex31 electrode	56 (67%)
Flex28 electrode	27 (33%)
Average follow-up (months)	27 ( $\pm$ 15 SD)

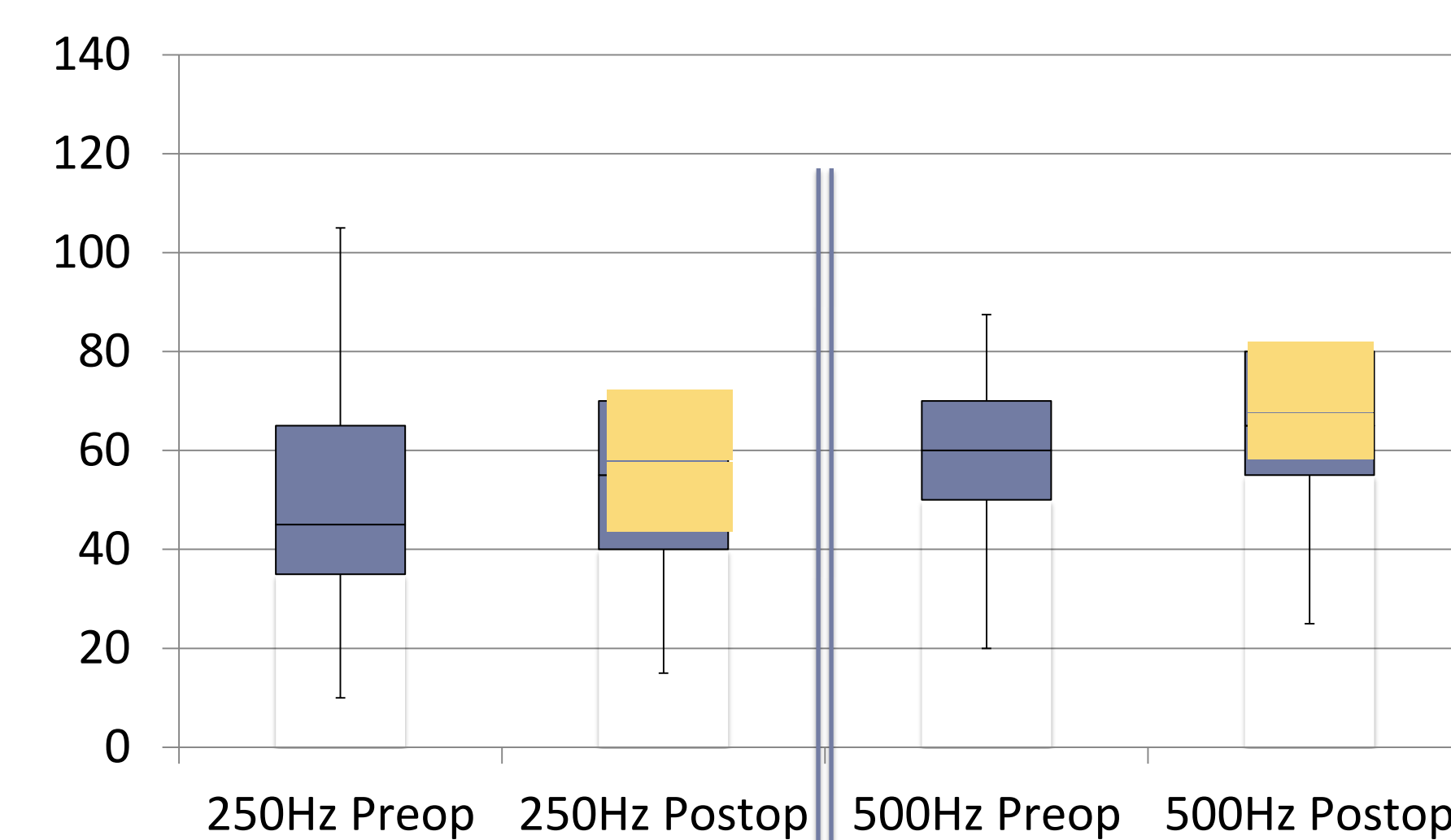
On the operative side, mean preoperative thresholds at 250Hz and 500Hz were 54 dB HL and 66 dB HL, which dropped postoperatively to 92 dB HL and 107 dB HL, respectively ( $p < .001$ ).

**Figure 1.** Operative Side Hearing Thresholds



On the contralateral side, mean preoperative thresholds at 250Hz and 500Hz were 49 dB HL and 62 dB HL, which dropped postoperatively to 56 dB HL and 70 dB HL respectively ( $p < .001$ ).

**Figure 2.** Contralateral Side Hearing Thresholds



Overall, in the contralateral ear, this amounts to a 7dB drop in hearing thresholds at the tested frequencies. At 250Hz, no correlation between threshold shifts emerged between the ears (Pearson's coefficient  $p = 0.07$ ,  $R^2 = 0.04$ )

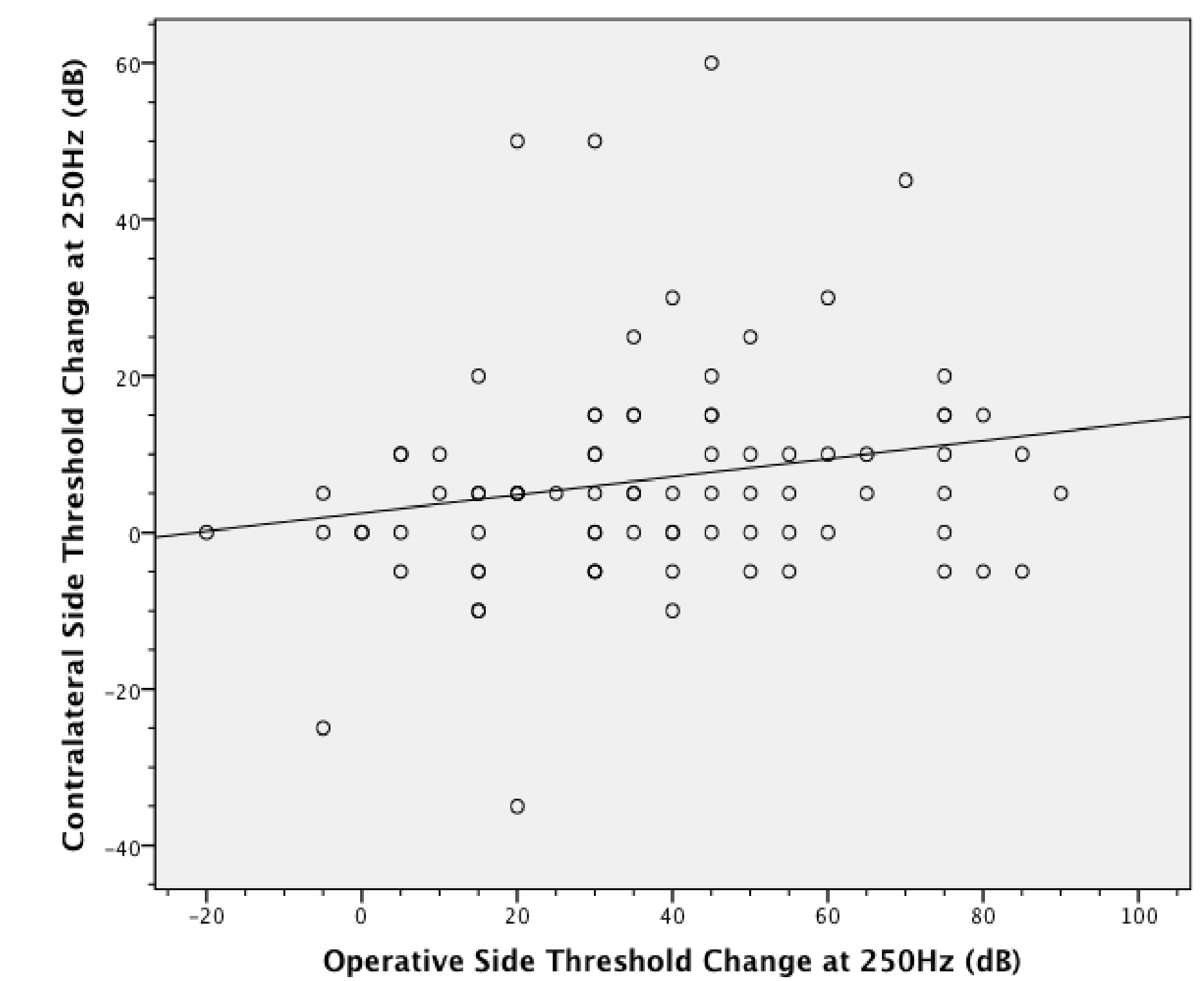
**Table 2.** Hearing Thresholds

Statistic	Operative Side 250Hz	Operative Side 500Hz	Contralateral Side 250Hz	Contralateral Side 500Hz
Preoperative				
Mean	54.1	66.3	48.7	62.2
Min	10.0	25.0	10.0	20.0
Max	110.0	95.0	110.0	125.0
Std Dev	20.1	15.2	19.9	17.4
Postoperative				
Mean	91.9	106.7	55.6	69.7
Min	55.0	65.0	15.0	30.0
Max	110.0	125.0	110.0	125.0
Std Dev	17.9	18.0	20.6	18.5

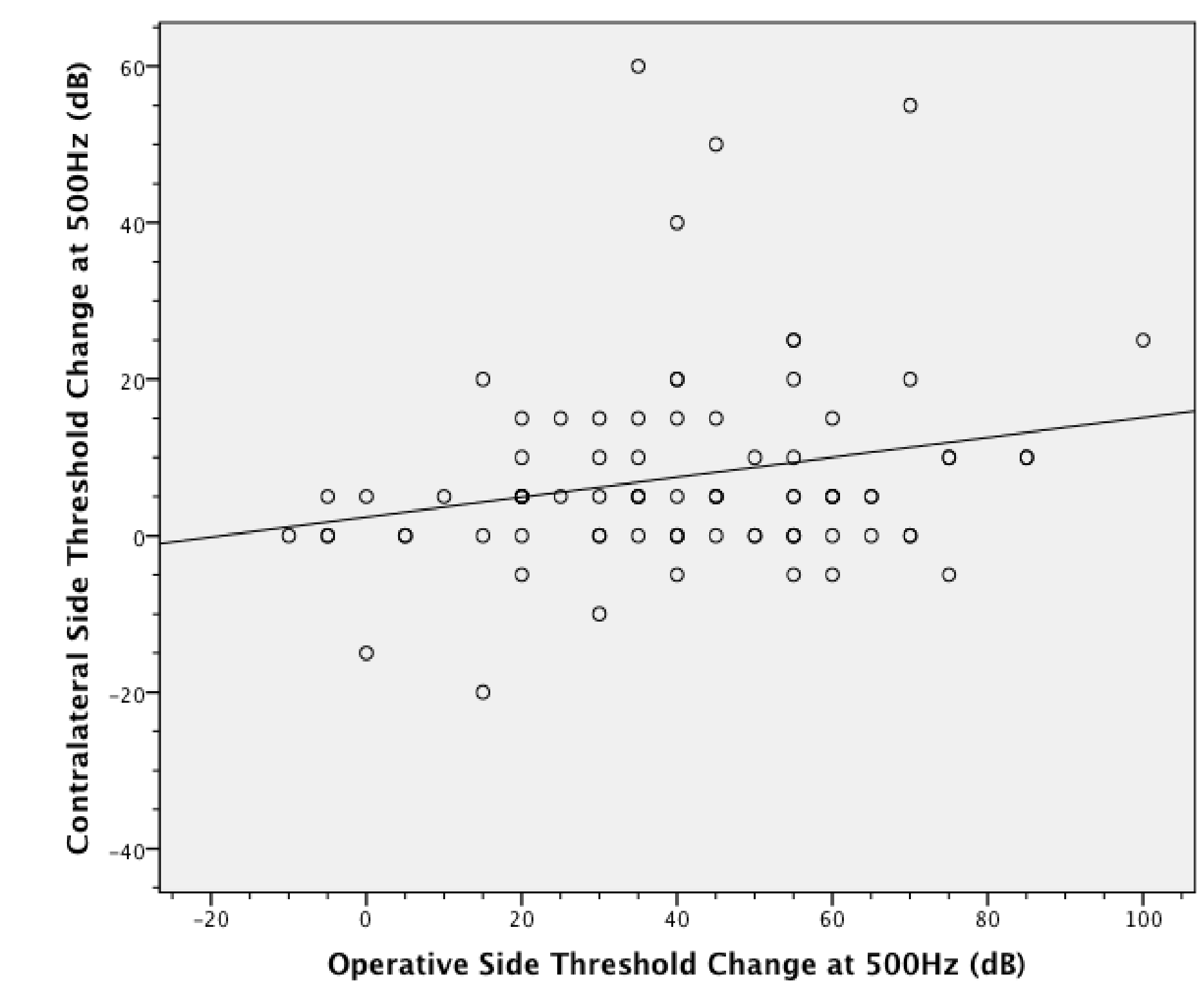
At 500Hz, a statistically significant correlation between threshold shifts was observed (Pearson's coefficient  $p = 0.04$ ,  $R^2 = 0.05$ )

## RESULTS

**Figure 3.** Threshold Change at 250Hz Scatterplot



**Figure 4.** Threshold Change at 500Hz Scatterplot



## DISCUSSION

Analysis of the hearing threshold changes in the contralateral ear show a progressive decline in hearing in patients who have undergone HPCI. It is noteworthy that a drop in the contralateral side was correlated with a drop in the operative side at 500Hz. We postulate that this could be caused by the ongoing systemic processes that caused the hearing loss in the first place. It is possible that some etiologies act bilaterally and progressively (eg: cochlear ossification), while others do not.

Further research looking closely at underlying etiology and rates of progression of hearing loss in HPCI will provide valuable insight into predicting hearing outcomes and help counsel patients before surgery.

## CONCLUSION

Our data shows an average 7 dB drop in hearing thresholds in the contralateral ears of our patients who received HPCI surgeries from 2008-2013. This natural progression of hearing loss is important to consider when interpreting the results of HPCI surgery.

Research into underlying etiologies and the effect on long term HPCI outcomes is needed.