

Stapes Prosthesis Length and Hearing Outcomes

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Abstract
Objectives: To determine first, if prosthesis length plays a role in optimizing successful hearing outcomes in stapedotomy surgery, and second if patient factors such as height had any predictive influence on the selection of the length of prosthesis.
Study Designs: Retrospective chart review.
Methods: Retrospective chart review of patients undergoing stapedotomy surgeries with adequate follow up. Length of prosthesis, pre/post-operative audiograms, and follow-up data was obtained.
Results: The primary group consisted of 227 cases. The prosthesis length ranged from 3.75mm to 4.75mm (median 4.25mm). The greatest closure of ABG was seen in the 4.75mm group, and the smallest in the 3.75mm group. Patient height showed a positive, although weak correlation with length of prosthesis. No findings reached statistical significance.
Conclusions: Accurate prosthesis length is important for successful post-operative hearing outcomes. There is a positive but not significant correlation between patient height and prosthesis length.

Introduction
 Primary stapes surgery performed for otosclerosis is a well-established procedure with good post-operative outcomes.¹ There are multiple surgical techniques, instruments and materials that can be utilized to perform the procedure.²⁻⁷ Little has been written about prosthesis length as it relates to hearing outcomes in primary stapes surgery for otosclerosis; despite multiple reports at the time of revision surgery indicating surgical failure may have been as a result of improperly sized pistons.⁸ The main objective of this study is to analyze the relationship of prosthesis length as it relates to hearing outcomes following primary stapes surgery. In addition, this study attempts to determine if there is a relationship between patient height and the length of prosthesis required.

Materials and Methods
 A case series with retrospective chart review identified 293 procedures performed between 1991-2016, with 227 meeting primary criteria. The criteria included 1) primary stapedotomy, (2) diagnosis of otosclerosis excluding other causes of stapes fixation, (3) KTP laser stapedotomy with or without drillout of footplate, (4) reconstruction with a piston prosthesis, (5) tissue sealing around the piston of the oval window fenestra, and (6) pre-operative and post-operative audiograms performed at our institution. The overall group contained variations in surgical technique, and the standard group had no variation and involved the standard laser, microdrill, and fat seal. The EMR was accessed to obtain patient height. Data collection included pre/post operative ABG, SNHL, SRT, and SDS. Anova test and basic linear regression were utilized for statistical analysis.

Results

Table 1. Demonstrates the outcomes for all primary stapedotomy procedures. Note the discrepancies between sample sizes.

Length	N	Change in Post-Op ABG (dB)	Post-Op Residual ABG (dB)	Change in sensorineural hearing level (dB)	Pre-Op SRT (dB)	Post-Op SRT (dB)	Pre-Op SDS(%)	Post-Op SDS (%)
3.75	14	16.52	16.25	3.33	54.64	33.92	94.29	94.14
4.00	50	21.11	8.59	4.53	50.5	25.3	96.66	98.21
4.25	120	20.91	7.28	5.61	48.12	22.5	97	97.29
4.50	38	20.86	8.65	4.47	50.95	23.51	95.24	95.88
4.75	5	19.75	4.00	3.33	45	18	98.4	100
overall	227	20.65	8.28	4.99	49.93	18.93	97.23	96.92

Table 2. Demonstrates outcomes for all standard, or uniform procedures that used the same technique with standard laser, microdrill, and fat sealant.

Length	N	Change in Post-Op ABG (dB)	Post-Op Residual ABG (dB)	Change in sensorineural hearing level (dB)	Pre-Op SRT (dB)	Post-Op SRT (dB)	Pre-Op SDS(%)	Post-Op SDS (%)
3.75	11	20.91	12.73	3.48	54.64	33.93	94.29	94.14
4.00	34	22.37	7.74	6.23	50.5	25.3	96.7	98.2
4.25	95	20.84	6.62	5.88	47.53	21.81	97.47	97.42
4.50	32	21.33	8.71	3.75	51.06	23.48	94.79	95.61
4.75	4	17.81	3.44	2.50	42.5	18.75	98	100
overall	176	21.16	7.53	5.33	49.18	23.13	96.40	97.06

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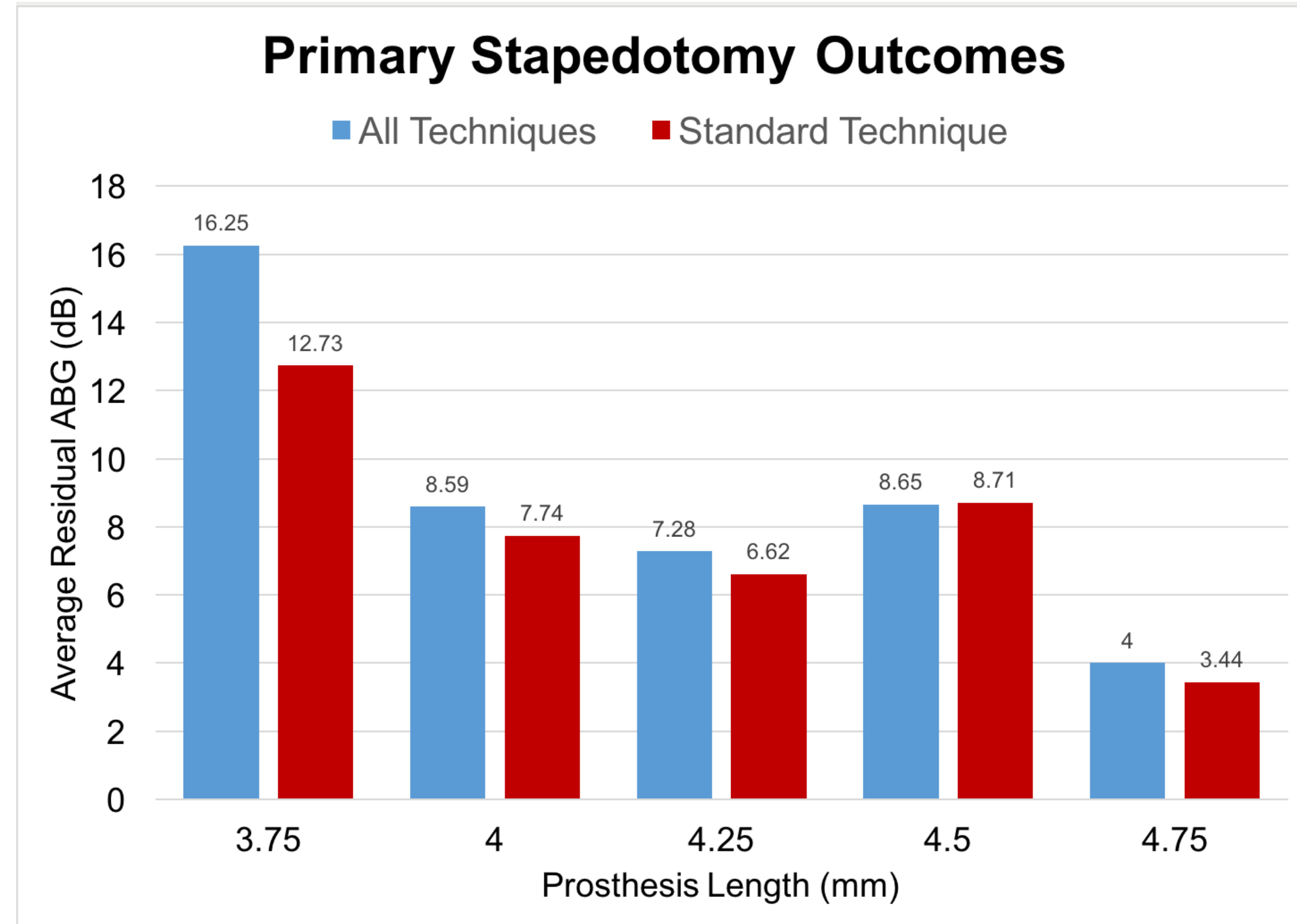


Figure 1. Prosthesis length and. average post-operative ABG.

Both groups, all techniques and standard technique are depicted. There was no statistically significant difference between these groups at each prosthesis length. In addition, there was no statistically significant difference between prosthesis size and average residual ABG. The 3.75mm prosthesis group, and 4.75mm prosthesis group had the highest, and lowest residual ABG respectively. However, there were large variations in sample sizes, with the 4.75mm group having the smallest n, followed by the 3.75mm group.

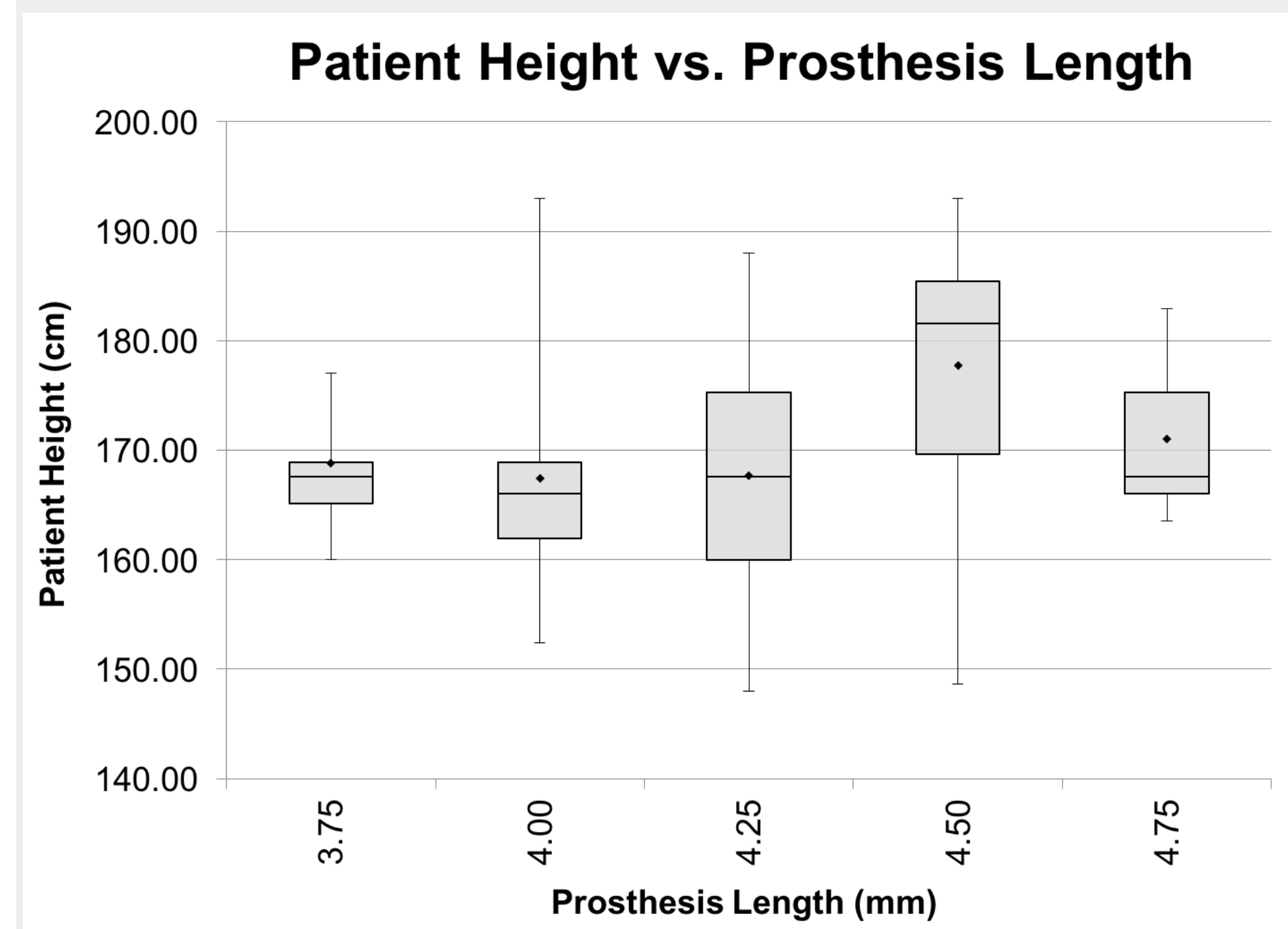


Figure 2. Box-Whisker plot demonstrating the distribution of patient height with respect to each prosthesis size. Whiskers depict range, IQR 25-75% formed by the box, with mean and median represented by point, and horizontal line respectively.

Length (n)	Average Height (cm)
3.75 (8)	168.9
4.00 (25)	167.4
4.25 (83)	167.7
4.50 (28)	177.8
4.75 (5)	171.1
r	0.546
r ²	0.298
p	0.65

Discussion

- Sample size was small for both the 3.75 and 4.75mm prosthesis groups, which interestingly had the highest and lowest average residual ABG respectively.
- The 3.75mm group was the smallest prosthesis used, and had the poorest outcomes with the highest average residual ABG. It is possible that the prosthesis utilized may have been undersized, despite proper measurement.
- While there was a trend, there was no statistically significant correlation between patient height and prosthesis length

Conclusion

This study demonstrates the variety of different sized prosthesis utilized in order to achieve successful hearing outcomes. There is no statistically significant relationship between prosthesis length and hearing outcomes. Patient height did not significantly correlate with prosthesis length.

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