

# Surgical Treatment for Recurrent Benign Paroxysmal Positional Vertigo

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Int Arch Otorhinolaryngol 2017;21:191–194.

## Abstract

**Introduction** Benign paroxysmal positional vertigo is a generally benign condition that responds to repositioning maneuvers and frequently resolves spontaneously. However, for some patients it can become a disabling condition in which surgery must be considered. Two different surgical techniques exist, singular neurectomy and posterior semicircular canal occlusion.

**Objective** The objective of this study is to review the current status of singular nerve section and posterior semicircular canal occlusion as treatments for intractable benign paroxysmal positional vertigo, and to determine if there are published data available that favors one over the other.

**Data Sources** MEDLINE and OLDMEDLINE databases of the National Library of Medicine.

**Data Synthesis** Four studies regarding singular neurectomy and 14 reports on semicircular canal occlusion were analyzed. Both techniques are reported to provide similar symptomatic benefit, with low risk of hearing loss and balance impairment. However, anatomical and clinical studies of singular neurectomy show it to be a more challenging technique, and considering that it is indicated in a very small number of cases, it may be difficult to master.

**Conclusions** Both singular neurectomy and semicircular canal occlusion can be safe and effective in those few patients that require surgery for intractable positional vertigo. Although semicircular canal occlusion requires a postauricular transmastoid approach, it is ultimately easier to learn and perform adequately, and thus may be considered the best alternative.

## Keywords

- ▶ benign paroxysmal positional vertigo
- ▶ vertigo/surgery
- ▶ semicircular canals
- ▶ otologic surgical procedures

## Introduction

Benign paroxysmal positional vertigo (BPPV) is a very common vestibular disorder, characterized by episodic vertigo following certain provocative head movements. It is considered to be the most frequent type of peripheral vertigo, although estimates regarding its frequency among patients with this type of symptoms vary between 5 and

40%.<sup>1,2</sup> Since the histopathologic studies of Schuknecht and Ruby,<sup>3</sup> in the early 70's, it has been regarded as a disease that originates in the posterior semicircular canal, yet many aspects of its pathophysiology remain uncertain.<sup>4</sup>

The vast majority of all BPPV cases are of the posterior canal variant. The pathophysiology that causes most of these cases is thought to be canalithiasis. This is probably because most of the free-floating endolymph debris tends to gravitate

received  
December 2, 2016  
accepted  
February 1, 2017

DOI <http://dx.doi.org/10.1055/s-0037-1599784>.  
ISSN 1809-9777.

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to the posterior canal, being the most gravity-dependent part of the vestibular labyrinth in both the upright and supine positions. Once the debris enters the posterior canal, the cupular barrier at the shorter, more dependent end of the canal blocks the exit of the debris. Therefore, the debris becomes "trapped" and can only exit at the end that has no ampulla (the common crus).<sup>5</sup> The prevalence of horizontal canal BPPV, although lower than that of the posterior canal type, is significant, accounting for up to 20% of the cases of paroxysmal vertigo<sup>6</sup>; the lower incidence is attributed to its spatial orientation, since the lateral canal slopes up and has its cupular barrier at the upper end. Therefore, free-floating debris in the lateral canal would tend to float back out into the utricle as a result of natural head movements. Superior canal involvement is exceedingly rare.

Current treatment of all forms of BPPV is mostly through canal repositioning maneuvers, developed to free the canal from lithiasis. Such maneuvers were described by Epley<sup>7</sup> and Semont,<sup>8</sup> and are very effective, with a success rate of up to 98% after three sessions. Furthermore, spontaneous resolution is frequent, usually occurring after 6 to 8 weeks of the initial symptoms; thus, BPPV is generally considered a benign disease.

However, positional vertigo is a potentially disabling condition, and a small fraction of the patients present symptoms and refractory vertigo after repeated canal repositioning maneuvers and physical therapy. For these patients, surgery may be considered- and various techniques have been proposed, including utricular ablation, microvascular decompression, singular nerve section (SNS), and two procedures that are considered as functionally equivalent, posterior semicircular canal occlusion (PSCO) and laser assisted "partitioning."<sup>9-14</sup> The only techniques that have been widely adopted, or that have been studied by more than one author, are posterior ampullary nerve ("singular nerve") section and semicircular canal occlusion (SCO). It is important to note that singular neurectomy is performed through an external ear canal approach, which can be done under local anesthesia, while SCO requires a retroauricular incision and simple mastoidectomy.

The objective of this study is to review the current status of these two procedures and to determine if published data exist to favor one over the other.

## Review of the Literature

### Search Strategy and Study Selection

Most publications regarding BPPV are not classified by its Medical Subject Heading (MESH) term. In fact, a search using that term only produces 193 publications. We, therefore, conducted a search through PaperChase, a service which provides Telnet access to all references found in the MEDLINE and OLDMEDLINE databases of the National Library of Medicine, and which can provide great granularity in its search terms. We then searched for publications containing any of the following words and/or MESH terms: "Benign Paroxysmal Positional Vertigo", "Positional", "Vertigo", "Postural", "Cupulolithiasis" and "Semicircular canals", which we then cross

referenced with "Vertigo/Surgery", which unites the term "Vertigo" with surgical treatment. In this way, we obtained a manageable amount of studies to analyze. The studies that met our inclusion criteria are summarized in ►Table 1. This cannot be considered as an exhaustive review, but considering the homogeneity of the results reported, it can be considered a representative analysis of the published data.

### Results

After reviewing the literature, it became evident that BPPV-related surgical cases have been decreasing since the early 1990s, presumably because of the emergence and high success rate of the repositioning maneuvers. It is also evident that singular nerve section (SNS), which was never widely adopted, seems to have been largely abandoned. Anatomical studies report a wide variation in the possibility of locating the singular nerve, ranging from 98%, in Kos et al,<sup>15</sup> to 20%, reported by Lewer et al.<sup>16</sup> Both authors agree, however, on the difficulty of correctly identifying the nerve through a surgical approach via the external ear canal. In 2008, Feigl et al<sup>17</sup> reported an interesting anatomical study in which they documented that a significant learning curve is needed to obtain adequate results. The largest series published are those of Silverstein and White,<sup>18</sup> in 1990, and Gacek,<sup>19</sup> in 1995; the latter reported, in an earlier study, an inability to locate the singular nerve in two of his first 12 patients (16%).<sup>20</sup>

In contrast with SNS, SCO is a much more straightforward technique, and thus, still a subject of study. Regarding published results and complications, by aggregating all the patients reported in the studies shown in ►Table 1, we can observe that SCO is reported to be successful in eliminating positional vertigo in 100% of the patients, which is somewhat difficult to believe, although some papers mention recurrence of vertigo through another canal, and Shaia et al<sup>21</sup> mention an 85% patient satisfaction rate, even though all patients had normalization of the Hallpike test. On the other hand, SNS is reported to be successful in 79 to 94% of cases, probably due to the anatomical difficulties mentioned above. Both techniques report a similar incidence of postoperative hearing loss, around 5%.

It is important to note that, although there would seem to be a slightly better success rate with SCO as compared to SNS, the majority of the studies analyzed do not evaluate postoperative vertigo using objective and quantifiable instruments, and those that do, differ between them. It is difficult to assure that the differences between the procedures regarding results are truly significant. Hearing loss is also loosely reported, with differing definitions of what constitutes hearing loss and whether or not it can be attributed to the procedures. Still, both techniques seem to provide important benefits, with an acceptable risk of hearing and balance loss in selected patients.

### Discussion

The choice between SNS and SCO for the few patients with intractable BPPV is based on the success rate and risk for

**Table 1** Success rate and incidence of postoperative hearing loss reported by different authors after singular nerve section or semicircular canal occlusion

Author	Year	Procedure	Number of procedures	Number of successful procedures (%)	Number of cases with postoperative hearing loss (%)
Gacek <sup>20</sup>	1978	SNS	12	10 (83.33%)	1 (8.33%)
Silverstein <sup>18</sup>	1990	SNS	49	39 (79.59%)	3 (6.12%)
Gacek <sup>19</sup>	1995	SNS	146	138 (94.52%)	4 (2.74%)
Pournaras <sup>22</sup>	2008	SNS	8	8 (100.00%)	2 (25.00%)
Parnes <sup>13</sup>	1990	SCO	2	2 (100.00%)	0 (0.00%)
Pace-Balzan <sup>23</sup>	1991	SCO	5	5 (100.00%)	0 (0.00%)
Anthony <sup>14</sup>	1991	SCO	2	2 (100.00%)	0 (0.00%)
Hawthorne <sup>24</sup>	1994	SCO	15	15 (100.00%)	0 (0.00%)
Zappia <sup>25</sup>	1996	SCO	8	8 (100.00%)	0 (0.00%)
Pulec <sup>26</sup>	1997	SCO	17	17 (100.00%)	0 (0.00%)
Walsh <sup>27</sup>	1999	SCO	13	13 (100.00%)	0 (0.00%)
Nomura <sup>28</sup>	2002	SCO	2	2 (100.00%)	0 (0.00%)
Shaia <sup>21</sup>	2006	SCO	28	28 (100.00%)	1 (3.57%)
Kisilevsky <sup>29*</sup>	2009	SCO	32	32 (100.00%)	0 (0.00%)
Ahmed <sup>30</sup>	2012	SCO	55	55 (100.00%)	9 (16.36%)
Beyea <sup>31</sup>	2012	SCO	77	77 (100.00%)	3 (3.90%)
Ramakrishna <sup>32</sup>	2012	SCO	12	12 (100.00%)	2 (16.67%)
Zhu <sup>33</sup>	2015	SCO	3	3 (100.00%)	0 (0.00%)

Abbreviations: SNS, singular nerve section; SCO, semicircular canal occlusion.

\* Kisilevsky et al report less than 10dB average loss by frequency.

hearing loss. This review would seem to indicate a slightly lower success rate for SNS, perhaps due to the difficulty in locating the singular nerve near the base of the round window. When performing a SCO, there are no troubles in locating the semicircular canals for any otologic surgeon, and the result in hearing preservation depends mostly on how carefully the canal is opened and manipulated. It is worth mentioning that we have also been using SCO as a conservative surgical procedure for patients with intractable Ménière's disease and serviceable hearing, and that our experience in avoiding hearing loss and controlling vertigo agrees with that of the studies we have reviewed. In our experience, SCO is a very straightforward technique and it avoids the anatomical difficulty of locating the singular nerve. Thus, we consider SCO as the technique of choice for those rare patients who require surgery for intractable positional vertigo.

## Final Comments

Both SCO and SNS are effective surgical options for patients with difficult to control, incapacitating, BPPV. Although SCO requires a retroauricular, transmastoid approach, it is an easier and safer procedure, thus it should be considered the best alternative.

## Conflict of Interest

The authors declare no conflicts of interest.

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