

2009

Effectiveness of the canalith repositioning procedure (CRP, or Epley maneuver) in treating adults with benign paroxysmal positional vertigo (BPPV)

Kristine Hostager
Pacific University

Alexandra Jakubowski
Pacific University

Follow this and additional works at: <http://commons.pacificu.edu/ptcats>



Part of the [Physical Therapy Commons](#)

Notice to Readers

This work is not a peer-reviewed publication. Though the author of this work has provided a summary of the best available evidence at the time of writing, readers are encouraged to use this CAT as a starting point for further reading and investigation, rather than as a definitive answer to the clinical question posed or as a substitute for clinical decision-making.

Select copyrighted material from published articles may be included in this CAT for the purpose of providing a context for an informed critical appraisal. Readers are strongly encouraged to seek out the published articles included here for additional information and to further examine the findings in their original presentation. Copyrighted materials from articles included in this CAT should not be re-used without the copyright holder's permission.

Recommended Citation

Hostager, Kristine and Jakubowski, Alexandra, "Effectiveness of the canalith repositioning procedure (CRP, or Epley maneuver) in treating adults with benign paroxysmal positional vertigo (BPPV)" (2009). *PT Critically Appraised Topics*. Paper 16.
<http://commons.pacificu.edu/ptcats/16>

This Critically Appraised Topic is brought to you for free and open access by the School of Physical Therapy at CommonKnowledge. It has been accepted for inclusion in PT Critically Appraised Topics by an authorized administrator of CommonKnowledge. For more information, please contact CommonKnowledge@pacificu.edu.

Effectiveness of the canalith repositioning procedure (CRP, or Epley maneuver) in treating adults with benign paroxysmal positional vertigo (BPPV)

Disciplines

Physical Therapy

Rights

Terms of use for work posted in CommonKnowledge.

CRITICALLY APPRAISED TOPIC

Title: Effectiveness of the canalith repositioning procedure (CRP, or Epley maneuver) in treating adults with benign paroxysmal positional vertigo (BPPV)

Overall Clinical Bottom Line: We evaluated three articles written between the years of 2000 and 2005 that assessed the efficacy of the canalith repositioning procedure (CRP, or Epley maneuver) to treat adults suffering from BPPV. These studies support the use of the CRP in treating BPPV in adults. The articles by Froehling *et al.* and Yimtae *et al.* both very closely matched our clinical question and were of excellent quality (ranking 9/10 and 7/10 on the PEDro scale, respectively). The Froehling *et al.* article was a randomized controlled trial with 50 adults with BPPV comparing the CRP to a sham maneuver. Yimtae *et al.* used a randomized controlled trial design with 58 adults with BPPV and compared the Epley maneuver and cinnarizine (anti-vertiginous drug) to cinnarizine alone. For elimination of vertigo symptoms, the NNT according to the Froehling *et al.* and Yimtae *et al.* studies was 4 (1.8 – 17.6) and 3 (1.8 – 5.4), respectively. The NNT to result in a negative Dix-Hallpike maneuver was 4 (1.8 – 60.8) for the Froehling *et al.* study and 4 (1.9 – 3.6) for the Yimtae *et al.* study. The data from the Yimtae *et al.* article also demonstrated a decreased use of anti-vertiginous medicine when subjects were treated with CRP as compared to the control group. Thus, treating BPPV with the CRP can help decrease adverse drug reactions. Although the article by Prokopakis *et al.* did not closely match our clinical PICO, it was an excellent descriptive study with a sample size of 592 adults with BPPV. This study supported the low incidence rate and severity of symptoms (74% of subjects experienced light-headedness for only 48-72 hours and 8% experienced severe nausea and vertigo) due to treatment with the Epley maneuver in a very large sample size. All of these articles had strong internal validity. Based on the evidence, we would confidently recommend the Epley maneuver as a safe and effective treatment for BPPV in adults. The data from these studies also demonstrate that the Epley maneuver is a high-benefit, low-cost treatment considering the short treatment time and minor nature and low rate of adverse effects.

Clinical Scenario: While on our clinical rotations, we saw patients who had or were suspected of having BPPV. All of these patients were in a hospital setting and were admitted for various reasons - not always for the vestibular dysfunction. Those who tested positive for BPPV were treated with the Epley maneuver. We wanted to know the evidence for the effectiveness of this treatment.

Clinical Question:

Population— Adults with benign paroxysmal positional vertigo

Intervention – Epley maneuver

Comparison – Placebo group

Outcome – Resolution of vertigo as confirmed by a negative Dix-Hallpike maneuver and a subjective report of decreased symptoms of vertigo

Search Terms: BPPV, Epley maneuver, vertigo, canalith repositioning procedure on Medline database

Appraised By: Kristine Hostager, SPT and Alexandra Jakubowski, SPT on 09/23/2009

Introduction

Vertigo is the most common vestibular dysfunction symptom. It occurs when a person has a sensation of movement that is not actually occurring (Lundy-Ekman, 2007). The most common cause of vertigo is a peripheral vestibular dysfunction called benign paroxysmal positional vertigo (BPPV; Parnes, *et al.*, 2003). The incidence of BPPV is 0.6% per year. This is an acute condition that always presents with a combination of positional vertigo and nystagmus, a rhythmical beating movement of the eye that can be horizontal, vertical, oblique, or even rotational (Lundy-Ekman, 2007, Parnes, *et al.*, 2003).

The diagnosis of BPPV is based on both subjective symptoms and objective signs. A provoking maneuver called the Dix-Hallpike test is used on patients who are complaining of vertigo symptoms and are suspected of having BPPV. It is performed by keeping the individual's head in slight extension and 45 degrees of rotation to the test side. The individual is then moved by the tester from sitting to supine. If there is an up-beating, rotatory nystagmus toward the ear that is lower, then the test is considered positive. A positive Dix-Hallpike test and complaints of vertigo symptoms are considered the gold standard for diagnosing BPPV (Halker, *et al.*, 2008).

It is theorized that BPPV is due to either canalithiasis or cupulolithiasis (Parnes, *et al.*, 2003). Both etiologies are explained by displacement of the otoconia from the macula due to trauma, infection, or unknown cause (Lundy-Ekman, 2007). Canalithiasis occurs when the displaced particles are floating in one or more semicircular canals resulting in abnormal flow of the endolymph (Parnes, *et al.*, 2003). The cupula is then bent by this flow and sends an incorrect signal to the brain regarding the body's movement in relation to gravity (Lundy-Ekman, 2007). Cupulolithiasis, on the other hand, occurs when the displaced particles stick to the cupula itself. Ultimately, this produces the same effect that canalithiasis does because it produces an abnormal bending of the cupula and an incorrect signal to the brain (Parnes *et al.*, 2003). Regardless of the theorized mechanism, both conditions result in vertigo.

Currently, the standard treatment for BPPV is the canalith repositioning procedure (CRP; Prokopakis, *et al.*, 2005). The CRP involves moving the person through a sequence of positions in an attempt to move the particles out of the semicircular canal so they will no longer trigger vertigo (Mayo clinic website, 2008). There are additional treatment techniques used for BPPV. These include the liberatory maneuver, which is similar to CRP, but the positions are different because it is based on cupulolithiasis as the cause of BPPV. Thus, the liberatory maneuver attempts to move the particles off the cupula. Because BPPV is an acute condition, it usually resolves within 6 months (Parnes, *et al.*, 2003). Treatment by the liberatory maneuver or the CRP allows the person to recover from BPPV relatively instantly instead of waiting for it to resolve on its own. For the minority of cases where BPPV does not resolve, there are surgical options. Currently, the surgery of choice for intractable BPPV is posterior semicircular canal occlusion. This surgery involves occluding the canal so the endolymph can no longer flow and thus cannot stimulate the nerves of the cupula to fire. It should theoretically work regardless of whether the BPPV is due to canalithiasis or cupulolithiasis (Parnes, *et al.*, 2003).

Article # 1: Froehling, D, Bowen, J, Mohr, D, Brey, R, Beatty, C, Wollan, P & Silverstein, M (2000) The Canalith Repositioning Procedure for the Treatment of Benign Paroxysmal Positional Vertigo: A Randomized Controlled Trial. *Mayo Clinic Proceedings* 75:695-700.

Clinical Bottom Line: In this randomized controlled trial with 50 adults, canalith repositioning procedure (Epley maneuver) was an effective treatment for benign paroxysmal positional vertigo (BPPV) as compared to a control sham maneuver. This study had strong internal validity due to single examiner blinding and successful randomization into groups. The NNT to resolve vertigo symptoms was only 4 (1.8-17.6) and the NNT to result in a negative Dix-Hallpike was 4 (1.8-60.8). An adverse event due to the Epley maneuver only occurred in one subject who vomited. The Epley maneuver only takes a few minutes to perform and no special equipment is required making it a high benefit, low cost treatment. The results of this study support using the Epley maneuver to treat adult patients who come to the clinic with BPPV.

Article Question

Population: Adults with benign paroxysmal positional vertigo (BPPV)

Intervention: Canalith repositioning procedure (CRP) as described by Epley (without use of mastoid oscillator)

Comparison: Sham maneuver

Outcome: Subjective reporting of vertigo symptoms and Dix-Hallpike head-hanging maneuver

PICO match: The article PICO is a very good match with our clinical PICO.

Blinding: Subjects were blinded and the control group received a sham maneuver. The nurse who collected the outcome measures was blinded to which group the subjects were in and the subjects were instructed not to describe the treatment they received to the nurse.

Controls: The researchers used an appropriate control group that was given a sham maneuver and the same instructions as the experimental group for what to do after the maneuver.

Randomization: The subjects were randomized into two groups with stratification to ensure equal representation of ages and gender in both groups. The researchers did not describe method of randomization, so it is uncertain whether randomization was concealed. Statistical analysis indicated no significant differences between groups, confirming that the randomization was successful.

Study: This prospective randomized controlled trial obtained subjects by convenience sampling of patients referred by their primary care physicians. There were 50 subjects randomly assigned into a treatment group (n=24) and a sham group (n=26). Inclusionary criteria included positional vertigo and positional nystagmus with either a right or a left Dix-Hallpike head-hanging position. Exclusionary criteria included gaze-evoked nystagmus, bilateral positive Dix-Hallpike maneuvers, evidence of ongoing central nervous system disease, otitis media, otosclerosis, and lack of tolerance for the Dix-Hallpike maneuver. The treatment group received the Epley maneuver (5 position CRP) with the modification that a

mastoid vibrator was not used. The time in each of the 5 positions was catered to each subject based upon the time it took for their positional nystagmus to present and resolve after the Dix-Hallpike maneuver. The sham group received a maneuver consisting of lying on the involved side for 5 minutes. Both groups were then given the same instructions for the week following the treatment. They were instructed to sleep sitting up while wearing a cervical collar for the first 2 nights, not sleep on the symptomatic side for 5 days more, and limit the rotation of their head during the first week.

Outcome Measures: Outcome measures were obtained 1-2 weeks after the initial treatment. These were all obtained by a single study nurse and consisted of a subjective report of vertigo resolution and a Dix-Hallpike maneuver objectively testing for positional nystagmus. The researchers did not report reliability or validity for either of the outcome measures. However, the Dix-Hallpike test is the gold standard for BPPV diagnosis, so it is considered a valid outcome measure (Halker, *et al*, 2008).

Study losses: No subjects were lost and all subjects were analyzed according to their initially assigned groups.

Summary of Internal Validity: Overall, this study had very good internal validity. The subjects were randomly assigned to groups, which were equal at baseline. Also, the administering of a sham maneuver minimized any outcome differences that could be attributed to the psychological impact of one group realizing that they had not been treated. Both the subjects and the nurse who did the outcome assessments were blinded to who had received the true treatment versus the sham. A minor potential problem was if any of the subjects explained to the nurse what type of maneuver they received. However, the researchers attempted to avoid this by explicitly telling both groups not to describe the maneuver to the nurse. The biggest threat to the internal validity is the unaddressed reliability of the maneuvers performed. However, we did not consider this a significant concern because all maneuvers were performed by two internal medicine doctors using the same detailed technique instructions. So, we may reasonably assume that the maneuvers were consistent enough to not threaten the consistency of the technique. Thus, the researchers minimized the differences between the groups so that the differences in outcome measures could be solely attributed to the intervention.

Evidence: Both outcomes in this study, the self-reported resolution of vertigo and the Dix-Hallpike maneuver, are relevant to our clinical PICO. This study conducted outcome assessments once per subject at 1 to 2 weeks after the Epley or the sham maneuver.

Table 1. Comparison of treatment and sham groups on BPPV signs and symptoms at 1-2 weeks post-intervention

Outcomes	ARR (95% CI)	NNT (95% CI)	RR (95% CI)
Vertigo symptoms	0.31 (0.06 – 0.56)	3.25 (1.8 – 17.6)	0.62 (0.40 – 0.96)
Positive Dix-Hallpike	0.28 (0.02 – 0.55)	3.55 (1.8 – 60.8)	0.54 (0.28 – 1.03)

For the subjective measure of reported vertigo symptoms, the absolute risk reduction of vertigo symptoms was 31% with a 95% confidence interval (CI) of 6% to 56%. The number needed to treat (NNT) to result in one less patient reporting vertigo symptoms was 4. Thus, for every 4 patients treated with CRP, 1 patient would no longer report having symptoms of vertigo. For the objective Dix-Hallpike maneuver, the absolute risk reduction of having a positive test was

0.28 [0.02-0.55]. The NNT to result in one less patient having a positive Dix-Hallpike maneuver was 4. The 95% CIs improve the strength of these data in that none of them go into the negative range, indicating that the sham maneuver would not be considered superior to the actual CRP maneuver if these procedures were performed in the larger population of patients with BPPV. However, the 95% CIs for the Dix-Hallpike maneuver are quite large. The NNT intervals go as high as 61, indicating that it could take up to 61 patients being treated with CRP to result in one patient not having a positive Dix-Hallpike test.

Applicability of study results

Similarity to our patients: The subjects were a very good match for our clinical PICO. They were adults who had positional vertigo and were referred by their primary care physician, which is a similar population seen in the clinic.

Benefits vs. Costs: The data analysis supports the effectiveness of the Epley maneuver for the treatment of BPPV over sham treatment as measured by a negative Dix-Hallpike test and subjective report of decreased vertigo symptoms. The groups were both only treated one time and received the same instructions regarding the week following treatment. Performing the Epley maneuver is a very affordable form of treatment. It requires fewer treatment sessions than exercises and does not require the physical therapist to have any special equipment. A NNT of only 4 for both outcome measures also supports the cost effectiveness of this treatment. Only two patients in this study had any negative side effects. One subject vomited during the maneuver and another subject did not follow the instructions and wore his cervical collar so much he developed a pressure sore. The Epley maneuver is a non-invasive, relatively risk-free treatment. Thus, the benefits are high and the costs are low.

Feasibility of treatment: Epley maneuver can be easily used in any clinic because it does not require any extra equipment. However, the authors noted that it can be challenging to perform in elderly or obese patients. The methods used to perform the maneuver were clearly explained and the technique used could be replicated based on their instructions. They only treated patients once, so this is definitely within the range that insurance companies would be willing to pay.

Summary of External Validity: Overall, the external validity for this study was good. The subjects were all referred by primary care physicians for positional vertigo, which is often how clinics receive their patients. These subjects appeared to be similar to patients seen in the clinic; however, the exclusionary criteria limited the applicability to patients who have complications in addition to BPPV. Also, the use of convenience instead of random sampling slightly decreases the ability to generalize. The internal validity was very good and thus does not hinder the generalizability. Thus, it appears that it is reasonable to generalize the results of this study to the population seen in clinic.

Article #2: Yimtae, K, Srirompotong, S, Srirompotong, S & Sae-seaw, P (2003) A Randomized Trial of the Canalith Repositioning Procedure. *The Laryngoscope* 113: 828-832.

Clinical Bottom Line: In this randomized controlled trial of 58 adults, canalith repositioning procedure (CRP, or modified Epley maneuver) in addition to cinnarizine (an antivertiginous drug) was a more effective treatment for benign paroxysmal positional vertigo (BPPV) compared to cinnarizine alone. The internal validity of this study was strong due to blinding of assessors and successful randomization into groups. The NNT to resolve subjective vertigo symptoms was only 4 (95% CI, 1.9 – 3.6) and the NNT to result in 1 less person having a positive Dix-Hallpike was 3 (1.8 – 5.4). Four subjects (7%) reported having fainting, pallor, and sweating from the CRP technique, but these resolved once treatment was finished. The CRP is an effective treatment that only requires a few minutes. Seven subjects in the treatment group and 14 subjects in the control group required more than one intervention. This procedure does not require additional equipment, thus keeping costs low. The results of this study support using the modified Epley maneuver in addition to cinnarizine compared to solely taking cinnarizine to treat patients who come to the clinic with BPPV. The mean duration of BPPV symptoms in this study for the treatment group was 31 days and 39 days for the control group.

Article PICO:

Population: 58 adults with posterior BPPV

Intervention: Modified Epley maneuver plus an antivertiginous drug (cinnarizine)

Comparison: Antivertiginous drug (cinnarizine)

Outcome: Dix-Hallpike maneuver and subjective reporting of vertigo symptoms

This article PICO is a good match with our clinical PICO.

Blinding: The authors did not mention whether the subjects were blinded. Therefore, it is uncertain whether the subjects were aware of whether they were in the treatment or the control group. A different physician who was blinded to group allocation performed the assessments. Thus, this was a single-blinded study.

Controls: This study had an appropriate control group that received the same medication and instructions as the treatment group. The only difference was they did not receive the CRP maneuver, which was the primary intervention being investigated.

Randomization: The subjects were randomized by stratification into treatment or control group using a block of four system. This randomization was successful as indicated by the fact that the groups did not have any significant differences at baseline.

Study: This was a prospective randomized controlled study of 58 subjects (43 females) obtained using convenience sampling from a single neurological clinic. The subjects were randomized into two groups of 29 using a block of four. Subjects within the control group received only medication, whereas the treatment group received medication and a modified Epley maneuver. Inclusion criteria were subjective complaints of vertigo and a positive Dix-Hallpike test. Exclusion criteria included subjects who had a neck problem or unstable

cardiopulmonary status. The treatment group received the modified Epley maneuver until nystagmus resolved with a maximum of 5 cycles. Modifications to Epley maneuver were positioning the subject prone for the 3rd position and then turning them in a circle before coming to a seated position for the 4th Epley position. The subjects then received a subjective assessment questionnaire and an antivertiginous drug with instruction to use it if they experienced vertigo. No instructions were given about avoiding any positions or limiting their movements post-treatment. The control group received the same medication, assessment questionnaire, and post-intervention instructions. Both groups were asked to rate their severity of vertiginous symptoms using the questionnaire and record the number of times they took the medication. The authors did not discuss whether they communicated with the subjects about recommended (or upper limits) of medication dosage or frequency. Subjects returned 1 week later for reassessment using the Dix-Hallpike maneuver. At the 1-week follow-up, if subjects had a negative a Dix-Hallpike test, they were given the subjective assessment questionnaire, medication, and appointment for a follow up 4 weeks later. Those in the control group who had a positive Dix-Hallpike test were reassured and scheduled to be seen every week for 5 weeks. The treatment group received the Epley maneuver and scheduled for weekly follow-ups.

Outcome measures: There were three outcome measures: subjective reporting of vertigo symptoms, amount of medication used, and results of the Dix-Hallpike test. Outcome measures were assessed during the 5 weeks following intervention. All the subjects kept record of their vertigo symptoms, and medication use during this time. Subjects who had a negative Dix-Hallpike at week 1 were only seen again at week 4. Subjects who had a positive test at week 1 were either treated with the maneuver again (treatment group) or verbally reassured (control group) and seen every week for 5 weeks. The objective assessment was performed by another blinded physician who recorded any nystagmus after the Dix-Hallpike maneuver.

Study Losses: Two subjects from the control group never came to the 1-week follow-up (7% total study loss), and the authors did not perform an intention-to-treat analysis.

Summary of internal validity: Overall, this study had good internal validity. All subjects were successfully randomized into groups and given the same instructions. Blinding of the physician doing the assessments minimized potential rater bias. The authors did not discuss the reliability of any of the outcome measures. However, a subjective report of vertigo in addition to a positive Dix-Hallpike test is the gold standard for BPPV diagnosis, so this combination would be a valid outcome measure (Halker, *et al.*, 2008). Only one physician performed the treatment maneuver, so there was not a concern of inter-performer reliability. However, a different physician performed the initial Dix-Hallpike test and the assessment Dix-Hallpike test. The researchers should have addressed the reliability between these two assessors. Another potential threat was absence of an intention-to-treat analysis due to the loss of 2 control subjects. We do not know how the missing data from these 2 subjects would have impacted the results, but since it represented only a 7% total study loss, it is unlikely that it would have significantly affected the analysis. A minor threat to internal validity was that the authors did not describe whether there was instruction on dosage or frequency of the medication. Some subjects may not have followed the prescribed dosage or frequency, and this could have altered their recovery. This is an area of less control within this study because ultimately the control group took more medicine than the treatment group creating an additional possible confounding difference between the 2 groups.

Evidence: The relevant outcome measures were subjective report of vertigo symptoms and the Dix-Hallpike test. We are interested in the short-term efficacy of the Epley maneuver, so data collected at 1 week post-treatment were most relevant.

Table 2. Comparison of treatment and control groups on BPPV signs and symptoms at 1-week post-intervention

Outcomes	ARR (95% CI)	NNT (95% CI)	RR (95% CI)
Vertigo questionnaire (subjective)	0.38 (0.18 - 0.57)	2.65 (1.8 – 5.4)	0.61 (0.44 -0.83)
Dix-Hallpike (objective)	0.28 (0.03 – 0.52)	3.61 (1.9 – 3.6)	0.47 (0.22 – 0.98)

Table 2 shows the data analysis for the subjective and objective outcome measures at 1-week post-intervention. At 1 week after intervention, there was a statistically significance between the objective outcomes of the treatment and control groups ($p=0.03$). The ARR of having a positive Dix-Hallpike test was 28% with a 95% CI of 3% to 52%. The NNT to result in one less patient reporting nystagmus was 4. This means for every 4 patients treated, 1 patient would be cured of BPPV as confirmed by a negative Dix-Hallpike test. At 1-week post-intervention, there was also a statistically significant difference between groups ($p= 0.01$) for the subjective assessment (vertigo questionnaire). For the subjective assessment, we were interested in which subjects had no symptoms, therefore, we grouped the subjects who reported their symptoms as “stable/worse” and “improvement” within the same group and compared these groups to the subjects who reported “no symptoms.” The ARR of having vertigo symptoms was 38% with a 95% CI of 18 – 57%. The NNT to result in 1 less patient reporting any vertigo symptoms was 3. The 95% CIs for both assessments strengthen the clinical significance of these data because neither go into the negative range. Therefore, the control (medication only) would not be superior to the treatment (Epley maneuver plus medication) in at least 95% of the general population with BPPV. Also, these are narrow confidence intervals, which further strengthen the results by showing there was less variability and a sufficient sample size. The NNT intervals only go as high as 5, indicating it could take up to 5 patients being treated with Epley maneuver plus medication to result in one patient not having BPPV symptoms. Thus, both the subjective and objective data strongly support the effectiveness of the modified Epley maneuver as performed in this study for the treatment of BPPV compared to medication alone.

Applicability of study results

Similarity to our patients: The subjects were adults with a positive Dix-Hallpike and vertigo symptoms, which is a very good match for our clinical PICO.

Benefits vs. Costs: This study supports the benefits of treating BPPV with a modified Epley maneuver in addition to medication (cinnarizine) as compared to cinnarizine alone. This combined treatment approach provided a more complete recovery and resulted in subjects taking less medicine. Performing the Epley maneuver is an affordable form of treatment. There are fewer treatment sessions necessary than exercise, and it does not require any special equipment. Only 4 subjects had complications from the Epley maneuver. Four subjects (14% of total subjects) experienced fainting, pallor, and sweating during the maneuvers, but these signs and symptoms resolved once the treatment stopped. Two (7%) other subjects had immediate symptoms of lateral BBPV on the same side, but this was immediately alleviated

with a CRP technique of the lateral canal. Overall, the modified Epley maneuver is highly effective at alleviating BPPV symptoms and decreasing medication use while keeping the costs and adverse effects low. One adverse drug reaction of cinnarizine is drowsiness. Performing the Epley in conjunction with cinnarizine can decrease the amount of medication used, which would decrease the frequency of this adverse drug reaction.

Feasibility of treatment: The modified Epley maneuver can easily be used in any clinic because it does not require additional equipment. With direct access and the inability of physical therapists to prescribe medication, further research is needed to distinguish the effects of the Epley maneuver compared to medication. The Epley maneuver can easily be replicated based on authors' descriptions. The authors also only treated patients for five weeks, which is likely within the range insurance companies would be willing to pay.

Summary of external validity: The subjects were similar to patients treated in clinic. The convenience sampling from only one specialized clinic decreases the ability to generalize the results to a larger clinical population. The mean chronicity of BPPV symptoms was 31 days and 39 days for the treatment and control group, respectively. Subjects with acute symptoms included 14 in the treatment group and 15 in the control group. There were 15 subjects within the treatment group and 14 in the control group with chronic symptoms. In clinic, we may see patients with acute cases or a flare-up of a chronic condition. Therefore, we are able to extrapolate our results to be effective for both conditions. The internal validity of this study was good and does not impair our ability to generalize the results.

Article #3: Prokopakis EP, Chimona T, Tsagourninsakis M, Christodoulou P, Hirsch BE, Lachanas VA, Helidonis ES, Plaitakis A, Velegrakis GA. (2005) Benign Paroxysmal Positional Vertigo: 10- Year Experience in Treating 592 Patients with Canalith Repositioning Procedure. *Laryngoscope* 115: 1667-1671.

Clinical Bottom Line: In this prospective study of 592 adults, canalith-repositioning procedure (CRP) was an effective treatment for benign paroxysmal positional vertigo (BPPV) over a long period of time. Although we were more interested in making a comparison with a control group and the short-term effects of the CRP, the purpose of this study was to assess the long-term efficacy of the modified CRP; thus, there was no control (or, sham maneuver) group. However, the internal validity was still strong due to the large sample size and the nature of this descriptive study design. At 2-days post-CRP, only 13% of the subjects had a positive Dix-Hallpike test (indicative of BPPV). At the 7-day reassessment, only 6% of the subjects had a positive Dix-Hallpike test. The authors stated that 84% of subjects required only 1 maneuver to resolve symptoms initially, whereas the other 16% required at least 2 maneuvers. Only 8% of subjects experienced severe nausea and vertigo. For 2-3 days following the CRP, 74% of subjects experienced instability or sensations of light-headedness. Overall, the large sample size provides strong evidence to support the use of the CRP maneuver to safely and effectively treat adult patients who come to the clinic with BPPV.

Article PICO:

Population: 592 adults with BPPV

Intervention: Epley's five positional cycle maneuver with and without Oster handheld vibrator

Comparison: None

Outcome: Negative Dix-Hallpike maneuver or Roll Test

The article PICO is relatively close to our clinical PICO, with the major difference being a lack of control group.

Blinding: There was no blinding in this study. Since there was only one group, the subjects could not be blinded to group allocation. For the same reasons, it was not necessary to blind the researchers.

Controls: There was no control group for comparison. The authors did a within-group pre- to post-treatment comparison looking at the recurrence of BPPV symptoms.

Randomization: The study was nonrandomized.

Study: This was a prospective study with 592 subjects (290 males and 302 females) between the ages of 18-84 years (mean age 59 years) followed over 10 years. Inclusion criteria were subjects' history and positive provocative maneuver with Dix-Hallpike at time of admission. Exclusion criteria were unstable heart disease, significant stenosis of carotid arteries, disorders of the spine, suspected central lesion, or Meniere's disease. The first 110 subjects with a posterior or anterior canal involvement received vibration with an Oster handheld vibrator. Remaining subjects were manually shaken or tapped on the cranium during CRP. Subjects

were left in each position of the CRP for approximately 3 minutes. Subjects were advised not to bend over, move their head up or down or lie supine for 2 days after treatment.

Outcome measures: Outcome measures were taken at initial evaluation, 48 hours, and 7 days after the maneuvers. Long-term follow-up was conducted by phone every 6 months for a mean of 46 months. The Dix-Hallpike (anterior and posterior canals) or Roll Test (horizontal canal) was used to determine positive diagnosis for BPPV. The authors did not site the reliability or the validity of the provoking maneuvers. However, the Dix-Hallpike test is the gold standard for BPPV diagnosis; therefore, it is considered a valid outcome measure (Halker, *et al.*, 2008).

Study Losses: Four subjects died during the study 17, 21, 39, and 42 months after short-term evaluation from unrelated causes. Thus, 99% (588/592) of the subjects completed the last follow-up. However, we were not interested in the long-term data, so all the subjects were included in the evidence that we analyzed.

Summary of internal validity: The primary threat to internal validity was the lack of a control group for comparison. Without management of this threat, we cannot eliminate the confounding factors of history and maturation. Rater bias for the Dix-Hallpike is not a significant concern since a positive test result is very apparent. However, during the long-term follow-up via telephone questionnaires, the raters could have asked leading questions that encouraged subjects to report relief of symptoms. The authors did not report reliability or validity of these questionnaires. The inter-performer reliability of the Epley maneuver is a potential threat because each performer may do the maneuver slightly differently. The Dix-Hallpike is used as the gold standard for BPPV diagnosis, so it is a valid outcome measure (Halker, *et al.*, 2008). To improve the internal validity of this study, the researchers should have incorporated a sham Epley control group for comparison and then blinding would also have been appropriate. The overall internal validity is strengthened by the large sample size.

Evidence: The study design was not a close match to our clinical PICO mainly because the authors were not making a comparison with a control group to determine the efficacy of the Epley maneuver. Instead, this was a descriptive study following a cohort over a mean of 46 months to look at the long-term response to the Epley maneuver. At the 2-day reassessment, 13% of subjects had a positive Dix-Hallpike test, indicating a return of symptoms as compared to baseline. That 13% received another round of CRP before they were reassessed in 7 days. After 7 days, only 6% of subjects had a positive Dix-Hallpike test. After a mean of almost 4 years, only 12% of subjects reported a reoccurrence of BPPV. The authors used a Kaplan-Meier analysis to extrapolate their results and estimated a recurrence rate of 18% by 10 years. The authors also recorded how many maneuvers it took for each patient to have a negative Dix-Hallpike at the original treatment. They found that 84% of subjects only required 1 maneuver to resolve symptoms initially, whereas the other 16% required at least 2 maneuvers.

Applicability of study results

Similarity to our patients: The subjects were 18-84 years old, which meets the age requirement of our clinical population. All of the subjects had a positive provocative test and a history indicating that they had BPPV, which is the same criteria we would use in clinic to identify patients who are appropriate for the Epley maneuver.

Benefit vs. costs: The Epley maneuver is efficient and affordable for patients and therapists. Once a positive provocative maneuver is recognized, therapists would be able to treat the patient with the appropriate maneuver the same day. The efficiency of this maneuver cuts the cost of repetitive treatments. In this study, 84% of subjects had a negative Dix-Hallpike after the first maneuver and all 592 subjects were relieved of symptoms with repeated maneuvers. Thus, the majority of patients would need only 1 maneuver to resolve symptoms and the maneuver could be repeated several times to relieve symptoms in less responsive patients. There is no additional cost for equipment. Also, the large sample size provides strong evidence for the low complication rate and lack of serious adverse effects due to the Epley maneuver. Only 8% of the subjects experienced severe nausea and vertigo which delayed the treatment. For the 48-72 hours following treatment, 74% of subjects experienced instability or sensations of light headedness. Overall, the Epley maneuver is a high-benefit, low-cost treatment for BPPV.

Feasibility: The maneuvers used to treat and reduce the recurrence of BPPV are very realistic and feasible for any clinical situation. There is no additional cost for equipment, which keeps cost of treatment low. Symptoms usually subsided within one to two treatments, lowering the number of treatment sessions. To perform this maneuver only takes about 15 minutes, which allows therapists to treat patients in a time-efficient manner. The procedures used to perform the maneuver were clearly explained and could be replicated.

Summary of External Validity: The subjects were similar to patients we would be treating in clinic. Because the researchers used convenience sampling instead of random sampling, we cannot be as confident that the results are truly representative of the general population seen in clinic. The lack of a control group undermines the ability to compare the effects of the Epley maneuver to a clinical population.

Synthesis/Discussion

We assessed the methodological quality of these 3 studies using the PEDro scale. Froehling, *et al.* scored 9/10; Yimtae, *et al.* scored 7/10; and Prokopakis, *et al.* scored 3/10. Prokopakis, *et al.* scored lower because it was a quasi-experimental study. Thus, for determining the efficacy of the Epley maneuver, the articles by Froehling *et al.* and Yimtae *et al.* provided stronger evidence. The article by Prokopakis *et al.* was more useful for looking at long-term effects and the safety of the Epley maneuver and re-occurrence rates.

The eligibility criteria for our articles were somewhat broad to allow us to find 3 articles that were pertinent to our topic. When limited our search to articles that were in English, had at least one group of subjects that was diagnosed with BPPV, and included the Dix-Hallpike as an outcome measure because it is considered part of the gold standard for BPPV diagnosis. This selection process produced 2 RCTs and 1 descriptive study that most closely matched our clinical PICO.

All 3 studies used the Epley maneuver as the primary treatment for BPPV, but the treatment parameters varied. Yimtae *et al.* and Froehling *et al.* performed the maneuver a maximum of 5 times. Prokopakis *et al.* did not have a limit; they performed the maneuver until subjects had a negative Dix-Hallpike test. One parameter that varied between the studies was that Froehling *et al.* and Prokopakis *et al.* gave the subjects very specific instructions limiting positions and movement following treatment whereas Yimtae *et al.* did not. The time in each position of the cycle was also different for each study. Froehling *et al.* based the time on the latency period of provoked nystagmus during the Dix-Hallpike, so the time varied for each subject. Yimtae *et al.* maintained each position until each subject's nystagmus stopped or for

20 seconds, if no nystagmus occurred. Prokopakis *et al.* held each position for 3 minutes. These studies did not exactly replicate the standard Epley maneuver. The article by Prokopakis *et al.* was the only study to use the mastoid vibrator and they only used it for the first 110 subjects. Yimtae *et al.* used modified Epley positions (3rd and 4th). Yimtae *et al.* was the only study to include medication as part of the treatment. The follow-up time also varied slightly between studies. Prokopakis *et al.* reassessed at 2 and 7 days; Yimatae *et al.* reassessed at 7 days, and Froehling *et al.* reassessed between 7-14 days. Table 3 shows that the studies by Froehling *et al.* and Yimtae *et al.* demonstrated clinically significant improvements in vertigo symptoms as indicated by low NNTs.

Table 3. Comparison of vertigo symptom outcomes

Articles	ARR (95% CI)	NNT (95% CI)	RR (95% CI)
Froehling <i>et al.</i>	0.31 (0.06-0.56)	3.25 (1.8-17.6)	0.62 (0.40-0.96)
Yimtae <i>et al.</i>	0.38 (0.18 - 0.57)	2.65 (1.8 – 5.4)	0.61 (0.44 -0.83)

Table 4 shows that these two studies also demonstrated clinically significant improvements in objective signs of BPPV. Both studies resulted in a NNT of only 4, allowing us to conclude that there was a clinically significant objective improvement due to the Epley maneuver. Yimtae *et al.* provided slightly stronger support because it had a much narrower 95% CI for NNT.

Table 4. Comparison of Dix-Hallpike outcomes

Articles	ARR (95% CI)	NNT (95% CI)	RR (95% CI)
Froehling <i>et al.</i>	0.28 (0.02-0.55)	3.55 (1.8-60.8)	0.54 (0.28-1.03)
Yimtae <i>et al.</i>	0.28 (0.03 – 0.52)	3.61 (1.9 – 3.6)	0.47 (0.22 – 0.98)

Table 5 shows the various adverse effects of the Epley maneuver experienced by subjects within the three studies we analyzed. Most adverse effects occurred at a low rate, were non-life threatening or severe, and did not persist. The only symptom that occurred at a high rate was sensations of light-headedness, but this only lasted 48 hours and was only seen in one study.

Table 5. Comparison of adverse events due to Epley maneuver

Articles	Emesis	Fainting, pallor, and sweating during maneuver	Nausea and vertigo	Sensations of light-headedness for 48 hours
Froehling <i>et al.</i>	4%	-	-	-
Yimtae <i>et al.</i>	-	7%	-	-
Prokopakis <i>et al.</i>	-	-	8%	74%

References

- Froehling, D, Bowen, J, Mohr, D, Brey, R, Beatty, C, Wollan, P & Silverstein, M (2000) The Canalith Repositioning Procedure for the Treatment of Benign Paroxysmal Positional Vertigo: A Randomized Controlled Trial. *Mayo Clinic Proceedings* 75:695-700.
- Halker, R, Barrs, D, Wellik, K, Wingerchuk, D & Demaerschalk, B (2008) Establishing a Diagnosis of Benign Paroxysmal Positional Vertigo Through the Dix-Hallpike and Side-Lying Maneuvers. *The Neurologist* 14:201-204.
- Lundy-Ekman, L (2007) *Neuroscience: Fundamentals for Rehabilitation, 3rd Ed.* 410-413.
- Mayo Clinic website (2008) Canalith repositioning procedure. *MayoClinic.com*.
<http://www.mayoclinic.com/health/canalith-repositioning-procedure/MY00085>
- Parnes, L, Agrawal, S & Atlas, J (2003) Diagnosis and management of benign paroxysmal positional vertigo (BPPV). *Canadian Medical Association Journal* 169:681-693.
- Prokopakis EP, Chimona T, Tsagourninsakis M, Christodoulou P, Hirsch BE, Lachanas VA, Helidonis ES, Plaitakis A, Velegrakis GA. (2005) Benign Paroxysmal Positional Vertigo: 10- Year Experience in Treating 592 Patients with Canalith Repositioning Procedure. *Laryngoscope* 115: 1667-1671.
- Yimtae, K, Srirompotong, S, Srirompotong, S & Sae-seaw, P (2003) A Randomized Trial of the Canalith Repositioning Procedure. *The Laryngoscope* 113: 828-832.