Scientific Research Publishing

International Journal of Otolaryngology and Head & Neck Surgery, 2022, 11, 143-153
https://www.scirp.org/journal/ijohns
ISSN Online: 2168-5460
ISSN Print: 2168-5452

Comparison of the Effectiveness of TRV Chair and Canalith Repositioning Procedure (CRP) for the Treatment of Benign Paroxysmal Positional Vertigo (BPPV)

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How to cite this paper: Yamout, A.K.A. (2022) Comparison of the Effectiveness of TRV Chair and Canalith Repositioning Procedure (CRP) for the Treatment of Benign Paroxysmal Positional Vertigo (BPPV). *International Journal of Otolaryngology and Head & Neck Surgery*, **11**, 143-153.
https://doi.org/10.4236/ijohns.2022.114016

Received: May 24, 2022
Accepted: July 8, 2022
Published: July 11, 2022

Abstract

The primary goal of this research is to evaluate the efficacy of traditional manual canalith repositioning procedures (CRP) to that of automated multi-axial repositioning chair (TRV). A total of 37 BPPV positive patients were distributed into two groups. The first group consisted of 20 patients, 10 under 50 years old (young group) and 10 over 50 years old (old group), who received TRV chair treatment, whereas the remaining 17 patients, 7 under 50 years old (young group) and 10 over 50 years old (old group) received CRP treatment. The DHI and VAS questionnaires were given to the patients before and after treatment, and the results were compared. The average VAS score for TRV patients was 84.5% (young group) and 77.5% (old group). These patients' DHI results were as follows: for young patients, 10% had a mild handicap, 80% had a moderate handicap, and 10% had a severe handicap, while for the elderly, 40% had a mild handicap, 40% had a moderate handicap, and 20% had a severe handicap. The results improved significantly after the first treatment session. Old patients had a VAS of 28%, 30% had a mild handicap and only 10% had a moderate handicap. However, only 43% of the young group and 30% of the old group who underwent standard CRP suffered from mild handicap and had a VAS of 20% and 34.3% successively. The third session revealed that all patients in the TRV chair group had no handicap, whereas the CRP patients indicated that they still had a mild handicap. Upon analyzing the results, both treatment methods revealed the same efficacy in treating single canal BPPV. However, TRV chair appeared to be superior to traditional CRP in treating multi-canal BPPV.

Keywords

Manual Repositioning Procedure, Vertigo, DHI, CRP, BPPV, VAS, TRV Chair

1. Introduction

Benign paroxysmal positional vertigo, commonly known as BPPV, is the most common cause of peripheral vertigo [1]. About 10% of the population have faced or will face an incidence of BBPV throughout their life [2]. This type of vertigo may affect people of all ages [2]; however, the chance of experiencing BPPV gets higher at a steady rate of 38% per 10 years of life, peaking at the ages between 50 - 70 years [2]. The displacement of the otoconia, which are crystals of calcium carbonate ($CaCO_3$), is what causes the person to experience this rotatory sensation [3]. This displacement is more of a detachment of the otoconia from the utricular macula into one or more of the semicircular canals where they move freely in the endolymph [3]. The otoconia's movement affects the sensory hair cells, which alters the signals sent to the central vestibular system [3]. These changes in signals from the peripheral vestibular system are what the person perceives as a rotatory sensation [3].

BPPV is diagnosed using a variety of maneuvers, primarily the Dix-Hallpike and Supine roll tests. In terms of treatment, a number of repositioning maneuvers are used to move the otoconia from the afflicted canal to the vestibule, where they dissolve [3]. The Barbeque, Epley, and Semont maneuvers are only a few examples [3]. During both of these maneuvers, manual or special equipment, such as the TRV chair, can be used to conduct both sorts of motions, whether for diagnosing or treating BPPV [3]. The TRV chair (Interacoustics, Denmark; TRV in honor of the creator Thomas Richard-Vitton) is a mechanical diagnostic and repositioning device designed to treat BPPV [4]. When utilizing this gadget, the examiner can effortlessly rotate the patient's body in a 360-degree motion along the plane of each semicircular canal [4]. Furthermore, the examiner can lock the patient's position in order to detect any changes over time [4]. To put it another way, this technique will assist the examiner in coming up with a more detailed diagnosis [4].

The purpose of this research is to compare the efficiency of various BPPV treatment techniques, including the TRV chair and manual repositioning maneuvers. The results of the comparison will be based on the patients' subjective experiences and will be displayed using self-assessment tools, namely The Dizziness Handicap Inventory (DHI) [5] and Visual Analog Scale (VAS) [6] questionnaires that aim to investigate any imprecise, vague, or even emotional description supplied by the patients.

2. Hypothesis

The TRV chair is more effective in the treatment of BPPV when compared to traditional manual canalith repositioning procedures (CRP).

3. Material and Methods

This is a subjective outcome of prospective observational cohort research. Patients were recruited from various ENT specialist's privet clinics and hospitals in

Lebanon. A total of 150 patients suffering from vertigo were included for the purpose of the study. Only adults with positional vertigo who had no history of vestibular labyrinthitis, neuritis, vestibular migraine, or other vestibular illnesses were included in the study (Figure 1). To rule out middle ear diseases and cervicogenic vertigo, these patients received audiometric testing (audiometry and immittance tests), neck tests, and vertebral artery tests. Patients who presented signs of the middle ear, cervical, or neck artery diseases were excluded from the study (Figure 1). Patients who weighed more than 150 kg or were taller than 195 cm were not included in the trial due to the TRV chair's weight and height restrictions. The remaining patients who had cupulolithiasis as determined by Dix-Hallpike, head hanging, and supine roll tests on the TRV chair were also excluded (Figure 1).

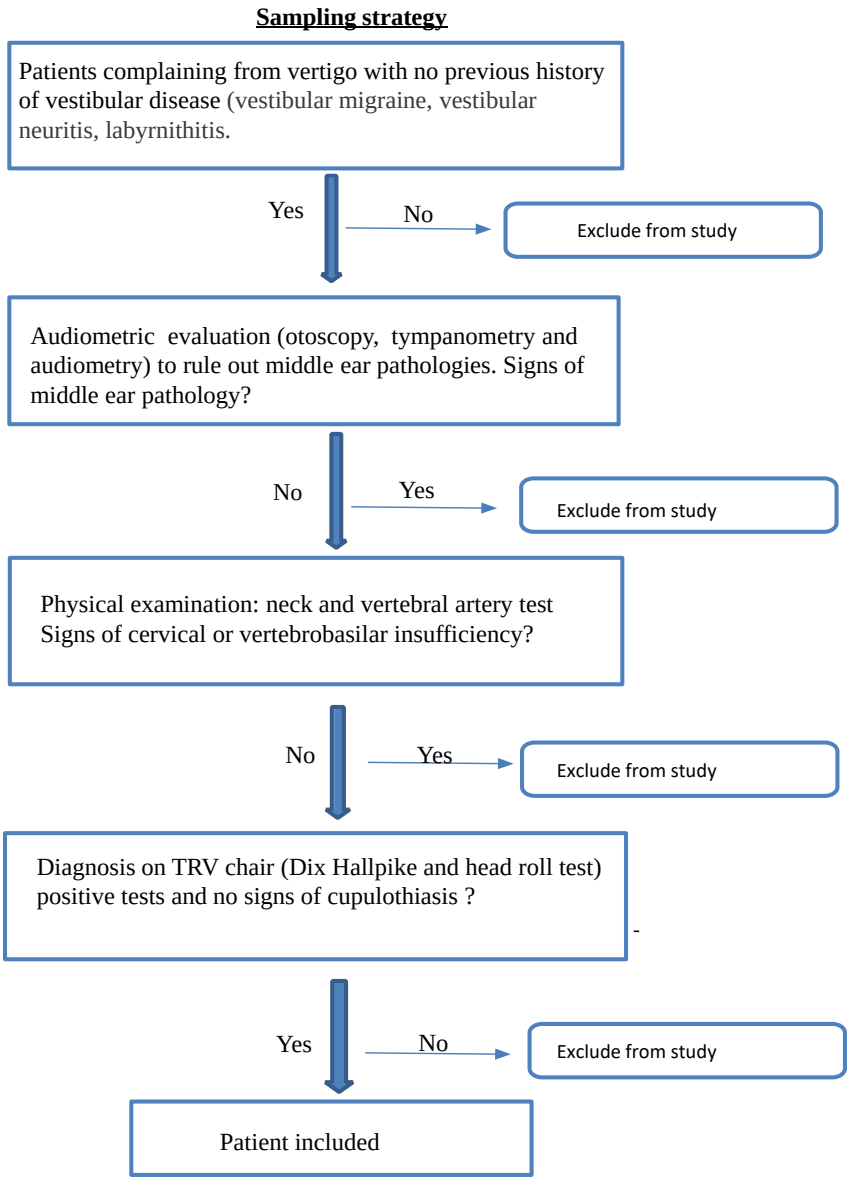

Figure 1. Inclusion and exclusion criteria for participant in the study.

A total of 37 patients were enrolled in the study and they were divided into two groups under the following groups:

A total of 20 patients in the intervention group that will be defined as patients in group A who will receive repositioning treatments on the TRV chair. Ten of them are under the age of 50, while the other ten are beyond 50.

A 17 in the control group, patients in group B, will undergo standard repositioning therapies. Seven of them are under the age of 50 and ten of them are over 50.

For manual repositioning, we considered the barbeque roll maneuver to treat canalolithiasis of the lateral canal, the Semont maneuver for posterior canal canalolithiasis, and the Yacovino maneuver for anterior canal canalolithiasis. As for the TRV chair, Dynamic Barbeque roll was used to treat canalolithiasis of the lateral canal, Semont maneuver for posterior canal canalolithiasis, and Lorin maneuver for anterior canal canalolithiasis.

During the session, all participants were required to fill out the Dizziness handicap inventory (DHI) and visual analogue scale (VAS). DHI is a 25-item survey created in 1990 for self-perceived handicap owing to a vestibular disorder. The items were divided into three content categories, each reflecting a different aspect of dizziness and unsteadiness: functional, emotional, and physical. Items are marked with 0 (no), 2 (sometimes), or 4 (yes) points and are summarized in a total grade ranging from 0 to 100 points. The VAS, on the other hand, is a tool for determining the severity of subjective complaints. It is frequently used to assess pain. It has, however, been used in the treatment of dizzy people. We used a 100 mm line on which the patient may mark the severity of their vertigo symptoms overall. As a result, the grade might be scaled from 0 to 100. A second session took place two weeks following the 1st session, all participants were required to fill out the DHI and VAS questionnaires again, and only patients whose VAS scores were greater than 20% were reevaluated on the TRV chair. Patients who were in group A received a second treatment on the TRV chair and group B underwent another treatment session using traditional CRP maneuvers. All subjects who completed the second CRP sessions were asked to complete the DHI and VAS questionnaires again after two weeks in the follow-up session. The findings are displayed based on the questionnaire's scores.

4. Results and Analysis

The period of data collection for this study was from mid-April through the end of December 2021. The TRV chair was used for repositioning treatments for patients in group A. A total of 20 patients were present (Table 2). Ten were under the age of 50, and the remaining ten were above 50. In group B, patients will undergo manual repositioning treatments. There are a total of 17 patients, with seven under the age of 50 and 10 above the age of 50 (Table 2).

The total number of participants was 37 patients with average age around 52 (Table 1), and the male ratio was half the female (14/23) with 19 cases (patients)

Table 1. Characteristics of total patients.

Total number of patients	Sex ratio Male/Female	Age (mean)	Ratio of affected SCCs (Single/Multiple)
37	14/23	51.5	19/18

had single affected canals and 18 patients had multi affected semi-circular canals (Table 1).

The characteristics of the patients in group A (TRV):

The total number of patients is 20, with 10 patients below the age of 50 having an average age of 38 years old, 60 percent of them are women and the remaining are men (Table 2). Their vertigo symptoms lasted an average of 22.7 months. A single canal was affected in 10% of the patients, whereas multiple canals were impacted in 90% (Table 2). On the other hand, the patient who had ages greater than 50 years, which were 10 in total, had an average age of 63 years, 60% were females and 40% were males (Table 2). The average duration of their symptoms was 39.5 months. Sixty percent of the patients had a single canal afflicted, whereas forty percent had numerous canals affected (Table 2).

The characteristics of the patients in group B (manual repositioning):

Group B had 7 patients under 50 years of age, those had an average of 35 years, 57% of which were females and 43% were males (Table 2). The average duration of their vertigo symptoms is 19.4 months (Table 2). A single canal was affected in 57% of these patients and 43% had multiple affected canals (Table 2). The other 10 patients who were above 50 years of age, had an average age of 65 years, 70% were females with 30% were males (Table 2). The average duration of their vertigo symptoms is 5.6 months, 80% had a single affected canal and 20% had multiple canals affected (Table 2).

The distribution of the affected semicircular canals (SCCs) for group A:

Only 10% of patients under the age of 50 years old had posterior SCC canalolithiasis, whereas 90% had both lateral and posterior SCC involvement (Table 3). In contrast, 10% of individuals over the age of 50 had unilateral lateral SCC involvement, 20% had bilateral lateral SCC involvement, 70% had solely posterior SCC involvement, and the rest had both lateral and posterior SCC involvement (Table 3).

The distribution of the affected semicircular canals (SCCs) for group B:

A total of 43% of patients under the age of 50 had unilateral posterior SCC involvement, 14% had unilateral lateral SCC involvement, 14% had bilateral posterior SCC involvement, and 28% had both posterior and lateral SCC involvement (Table 3). Meanwhile, among individuals above the age of 50, 70% had unilateral posterior SCC involvement, and 10% had unilateral lateral SCC involvement; bilateral lateral SCCs were affected in 10% of those patients, and the same was for bilateral posterior SCCs. Table 4, Figure 2 and Figure 3 showed the results of both groups via DHI and VAS questionnaires (Table 3).

In the 1st session, the DHI scores for patients whose age was less than 50 in

Table 2. Characteristic of patients of both groups.

		Total number	Age (years, mean (±SD)	Sex (%) Female/male	Duration of symptoms (Months)	Affected scc, number (%)
Group A (TRV)	young	10	37.8	Female = 60% Male = 40%	22.7	Single scc = 10% multiple SCC = 90%
	old	10	63.2	Female = 60% Male = 40%	39.5	Single scc = 60% multiple SCC = 40%
Group B (traditional CRP)	young	7	35.3	Female = 57% Male = 43%	19.4	Single scc = 57% multiple SCC = 43%
	old	10	64.8	Female = 70% Male = 30%	5.6	Single scc = 80% multiple SCC = 20%

Table 3. Distribution of affected SCCs of both groups.

		Posterior SCC (%)	Lateral SCC (%)	Bilateral lateral SCCs (%)	Bilateral posterior SCCs (%)	Posterior + lateral SCCs (%)
Group A (TRV)	young	10	-	-	-	90
	old	50	10	20	-	20
Group B (CRP)	young	43	14	-	14	28
	old	70	10	10	10	-

Table 4. The results of both groups.

		1st session				2nd session				Follow up		
		DHI (Handicap)			VAS (%)	DHI (Handicap)			VAS (%)	DHI (Handicap)		VAS (%)
		Mild (%)	Moderate (%)	Severe (%)		No handicap	Mild	Moderate		No handicap	mild	
Group A (TRV)	young	10	80	10	84.5	50	50	-	24	100		0
	old	40	40	20	77.5	60	30	10	28	100		0
Group B (CRP)	young	57	43	-	65.7	57	43	-	20		100	38.3
	old	30	50	20	80	70	30	-	24.3		100	40

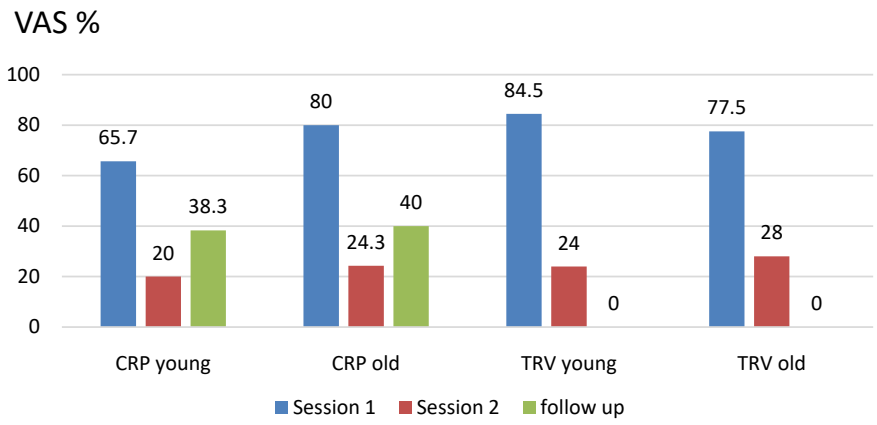

Figure 2. Shows the VAS results during sessions for all groups.

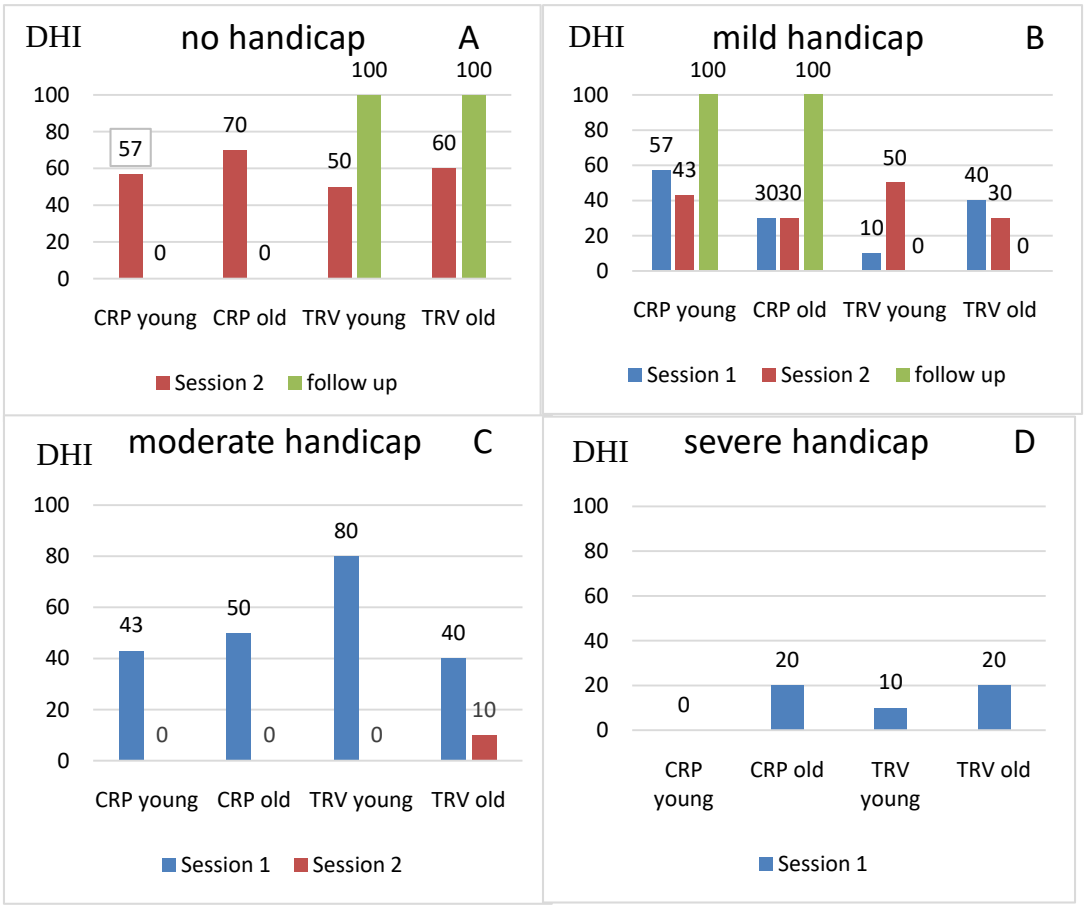

Figure 3. (A)-(D) figures show the results of the DHI for all groups during sessions with (A) no handicap, (B) mild handicap, (C) moderate handicap and (D) severe handicap.

group A revealed that 10% of those had mild handicaps due to their vertigo, 80% had a moderate handicap (Table 4), and 10% had a severe handicap (Table 4). The average VAS score for the patients in group A was 84.5% (Table 4). Meanwhile, for patients aged above 50, DHI scores revealed that 40% of the patients had a mild handicap, 40% had a moderate handicap, and 20% had severe handicap due to their vertigo (Table 4). The average VAS result for these patients was 77.4% (Table 4).

The DHI results for patients in group B aged less than 50 years revealed that 57% of those had a mild handicap and 43% had a moderate handicap due to their dizziness (Table 4). Their average VAS score was 65.7%. On the other hand, for patient's aged above 50, DHI scores suggested that 30% of the patients had a mild handicap, 50% had a moderate handicap and 20% had severe handicap due to their dizziness (Table 4). The average VAS result for them was 80% (Table 4).

In the 2nd session, the DHI results for patients in group A that are under 50 years of age were as follows: 50% had a mild handicap, 50% had no handicap (Table 4). The average VAS result for those was 24% (Table 4). However, the results for patients belonging to the same group but whose ages were above 50

were as follows: 30% had a mild handicap, 10% had a moderate handicap and 60% had no handicap and their average VAS result was 28% (Table 4).

On the other hand, DHI results for the patients in group B that are under 50 years of age were as follows: 43% had a mild handicap, 57% had no handicap and their mean VAS result was 20% (Table 4). While those aged above 50 years old had the following results: 30% had a mild handicap, and 70% had no handicap (Table 4). Their average VAS result for them was 24.3% (Table 4).

In the follow-up session, the DHI results of all patients in group A -are under or over 50 years of age -revealed no handicap with an average VAS result of 0% (Table 4). However, for those in group B whose age is under 50, DHI scores revealed that all patients post the follow-up treatment session had a mild handicap and their average VAS was 38.3% (Table 4). The patients whose age was above 50 demonstrated the same DHI results (mild handicap) and the average VAS was 40% (Table 4).

5. Discussion

The aim of this study is to compare the effectiveness of traditional manual canalith repositioning maneuvers to that of automated multi-axial repositioning chairs. Specifically, Thomas Richard Vuitton's repositioning chair is known as the TRV chair in treating patients with Benign Proximal Positional Vertigo (BPPV).

There have been several trials evaluating BBPV treatments (CRP versus TRV) in various afflicted canals. We chose three studies that are comparable to ours.

The first study we considered was performed by Tan (type of study: prospective) [7]. It had 165 patients with unilateral p-BPPV who were randomly allocated to either the CRP or TRV groups. The major age for CRP was 55.1 and for the TRV was 52.5 (the sex ratio for CRP was 21/36 and TRV was 23/58). Patients were evaluated after their first treatment at 1 week, 4 weeks, 3 months, and 6 months. At 4 weeks, 3 months, and 6 months, the number of therapy sessions necessary for effective repositioning in both groups were documented. It was obtained that: one week following the first therapy, patients in the TRV group had significantly superior treatment efficacy than those in the CRP group. At 4 weeks and 3 months following the first treatment, the number of treatment sessions required for effective relocation was markedly lower in the TRV group than in the CRP group.

The second study we considered was that of West (kind of study prospective) [8] in which 150 consecutive patients with refractory vertigo were referred to his clinic over a 10-month period (Sex ratio 68/28 and mean age 60 years). Classic manual maneuvers, the Epley Omniax rotator (EO), or the TRV chair were used to treat BPPV patients (TRV). BPPV was found in 95 of the patients. There was a significant difference in the number of treatments required for posterior canalolithiasis vs posterior cupulolithiasis, horizontal cupulolithiasis, and multi-canal affection. Thirty-seven patients (38%) only required one repositioning maneuver, with overall symptoms relief ranging from 91.7% to 100% after three treat-

ments. Recurrence occurred in 11 patients (12%) over the 6 months follow-up period. Horizontal cupulolithiasis and multi-canal involvement were the most resistant cases. A review of the literature revealed nine different types of repositioning chairs; in cases with BPPV that are very difficult and recalcitrant, the EO and TRV can be very helpful in diagnosing and managing the BPPV.

Another study conducted by West (also the type of study was prospective) [9] was also considered. It included 31 patients (mean age 56.9, sex ratio 18/8) with refractory BPPV who had failed conventional repositioning treatment. Patients completed the Dizziness Handicap Inventory (DHI), the Visual Analog Scale (VAS), and the Hospital Anxiety and Depression Scale at the start of each session (HADS). Every two weeks, the treatment and re-evaluation were done until the patient was proclaimed disease-free. BPPV remission took an average of two treatments to achieve. The mean DHI score dropped from 45 points before the first therapy to 22 points after the treatment was completed. Similarly, the mean VAS score dropped from 58 to 25 points, and the HADS score dropped from 8 to 5. Cupulolithiasis patients complained of more vertigo than those with canalolithiasis. According to all subjective outcomes, patients with refractory BPPV improved considerably with reposition chair therapy. As a result, the repositioning device has the potential to considerably reduce the disease burden in individuals with BPPV who have not responded to traditional treatment. The strong correlation between the scores shows that VAS might be a valuable tool for patients with vertigo-related complaints.

According to the mean age and sex ratio, the features of our patients' number match the literature of the third research (**Table 5**). The first and second studies vary because they include a larger number of patients (**Table 5**).

Our findings demonstrate that during the follow-up session, all TRV (group A) patients had a zero VAS score. The same can be said for CRP (group B) patients with a single afflicted canal. However, the patients with several affected canals who belong to group B (approximately four patients) continued to have vertigo and felt unwell, and their VAS was 38.3% and 40%, respectively.

In our research, we discovered that the TRV chair is more beneficial than the CRP for multi-affected canals. Because we can easily spin the patient and turn the chair 360 degrees for repositioning, the kinetic energy will speed up the migration of the smaller otoconia that would otherwise stay put.

In every study, the TRV chair outperforms the manual repositioning procedure.

In the first study, the number of treatment sessions for effective repositioning was lower in the TRV chair than in the CRP chair for unilateral posterior BPPV (**Table 6**).

In the second study, mechanical chairs (EO/TRV) were compared to manual repositioning for diagnosis and management of all subtypes of BPPV (Posterior canalolithiasis/cupulolithiasis, Lateral cupulolithiasis + multi-canals) (**Table 6**). The results showed that EO and TRV chairs are highly valuable assets in BPPV diagnosis and management (**Table 6**).

Table 5. Comparison of the characteristics of our study with similar ones.

	Yamout, 2022	Tan, *et al.*, 2014 [7]	West, *et al.*, 2015 [8]	West, *et al.*, 2019 [9]
Patient number (n)	37	165	95	31
Mean age (years)	51.5	53.8	60	56.9
Sex ratio (M/F)	14/23	44/121	28/67	8/18

Table 6. Comparison of the results of our study with other ones.

	Yamout, 2022	Tan, *et al.*, 2014 [7]	West, *et al.*, 2015 [8]	West, *et al.*, 2019 [9]
Objective (Aim)	Comparison between CRP and TRV chair	Comparative study of the efficacy of the canalith repositioning procedure versus the vertigo treatment and rehabilitation chair	Repositioning chairs in benign paroxysmal positional vertigo: implications and clinical outcome	Reposition chair treatment improves subjective outcomes in refractory benign paroxysmal positional vertigo
Type of study	Prospective	Prospective	Prospective	Prospective
Type of BPPV	Lateral and posterior canalolithiasis + multi-canals	Unilateral posterior BPPV	Posterior canalolithiasis/ cupulolithiasis, Lateral cupulolithiasis + multi-canals	All types of refractory BPPV
Conclusion	TRV chair is more effective in treating multi-canals BPPV	Number of treatment sessions for successful repositioning is lower in TRV chair than in the CRP.	The EO and TRV chairs are highly valuable assets in diagnosis and management of BPPV.	Patients with refractory BPPV improved significantly by TRV chair.

In the third study, individuals with refractory BPPV were studied (all types of BPPV). Patients with refractory BPPV benefitted greatly from the TRV chair (Table 6).

TRV chair is more beneficial for multi-affected canals in therapy, according to our findings, which seem to be consistent with other research findings (Table 6).

For future ideas, the study that will be conducted for comparison between TRV chair and manual manoeuvres should have more number of patients, more complicated cases: cupulolithiasis-Apo geotropic, multi-affected semi-circular canals, neck and back pain patients and overweight patients (100 - 150 Kgs) (Table 6).

6. Conclusions

The comparison of both BPPV treatments (TRV, manual CRP) according to subjective outcomes measured by the DHI and VAS questionnaires for both groups (young and old) via three sessions (two treatment sessions and one follow-up), showed that the TRV chair treatment is more effective for BPPV treatment of multiple affected semi-circular canals than the manual canalith repositioning procedure, as evidenced by the previous findings. Where we found that all the TRV patients end with no handicap, while the manual CRP ends with 4

patients still having vertigo (mild handicap). The TRV is an immensely helpful tool in the management of BPPV especially in multi-affected canals.

Based on the experimental results, it is better to treat BPPV patients with TRV chair than CRP in all cases and specially the affected multi canals cases.

Acknowledgements

Acknowledgment to Yamout Hearing Center in Beirut Lebanon.

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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