



## SPECIAL ARTICLE COVID-19

# Teleconsultation and Teletreatment Protocol to Diagnose and Manage Patients with Benign Paroxysmal Positional Vertigo (BPPV) during the COVID-19 Pandemic

Renato Gonzaga Barreto<sup>1,2</sup>  Darío Andrés Yacovino<sup>3,4</sup>  Lázaro Juliano Teixeira<sup>5,6</sup>   
Mayanna Machado Freitas<sup>7</sup> 

<sup>1</sup>Clínica Otorrino Premier, Ilhéus, Bahia, Brazil

<sup>2</sup>Faculdade Madre Thaís, Ilhéus, Bahia, Brazil

<sup>3</sup>Otovestibular Section, Neurology department, Dr. Cesar Milstein Hospital, Buenos Aires, Argentina

<sup>4</sup>Memory and Balance Clinic, Buenos Aires, Argentina

<sup>5</sup>Prefeitura Municipal, Balneário Camboriú, SC, Brazil

<sup>6</sup>Consultório Particular, Balneário Camboriú, SC, Brazil

<sup>7</sup>Fundación Hector Alejandro Barceló, Buenos Aires, Argentina

Address for correspondence Renato Gonzaga Barreto, PT, MS, Av. Osvaldo Cruz, 74; Edf. Premier, 3° Andar; Salas 316, 317 e 318, Cidade Nova, Ilhéus, BA (e-mail: ft.renato@hotmail.com).

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## Abstract

**Introduction** Telehealth consists in the application of technology to provide remote health service. This resource is considered safe and effective and has attracted an exponential interest in the context of the COVID pandemic. Expanded to dizzy patients, it would be able to provide diagnosis and treatment, minimizing the risk of disease transmission. Benign paroxysmal positional vertigo (BPPV) is the most common vestibular disorder. The diagnosis typically rests on the description of the symptoms along with the nystagmus observed at a well-established positional testing.

**Objectives** The aim of the present study was to propose a teleconsultation and teletreatment protocol to manage patients with BPPV during the COVID-19 pandemic.

**Methods** Specialists in the vestibular field met through remote access technologies to discuss the best strategy to manage BPPV patients by teleconsultation and teletreatment system. Additionally, several scientific sources were consulted. Technical issues, patient safety, and clinical assessment were independently analyzed. All relevant information was considered in order to design a clinical protocol to manage BPPV patients in the pandemic context.

**Results** Teleconsultation for BPPV patients requires a double way (video and audio) digital system. An adapted informed consent to follow good clinical practice statements must be considered. The time, trigger and target eye bedside examination (TiTRaTe) protocol has proven to be a valuable first approach. The bow and lean test is

## Keywords

- ▶ COVID-19
- ▶ telemedicine
- ▶ dizziness
- ▶ vertigo
- ▶ therapeutics

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the most rational screening maneuver for patients with suspected positional vertigo, followed by most specific maneuvers to diagnostic the sub-variants of BPPV.

**Conclusion** Although with limited evidence, teleconsultation and teletreatment are both reasonable and feasible strategies for the management of patients with BPPV in adverse situations for face-to-face consultation.

## Introduction

In late December 2019, a novel coronavirus disease (COVID-19) emerged and spread throughout the world, acquiring the category of pandemic by the World Health Organization (WHO) in 2020. Its genome sequencing was discovered and classified as a new genus of Beta Coronavirus by the International Committee on Taxonomy of Viruses (ICTV).<sup>1-4</sup>

Nonpharmacological interventions to reduce the transmission rate of the virus are recommended by the WHO, including social distance,<sup>5</sup> social isolation<sup>6,7</sup> and quarantine.<sup>5,6</sup> These measures, basically, attempt to reduce the social interaction between symptomatic, infected but asymptomatic and non-affected subjects.<sup>4</sup> The results of these measures are particularly relevant to social groups in risk of suffering a severe disease, such as older people.<sup>6</sup>

Although correctly applied, “anti-Covid 19” social strategies have shown to be effective, they were associated with substantial economic, social and public health side effects.<sup>8,9</sup> The impact on other pathologies associated with very low or no mortality, but with high prevalence, such as vestibular disorders, have not been studied in the context of the pandemic.

Benign paroxysmal positional vertigo (BPPV) is the most common peripheral vestibular disorder, with a higher prevalence in women.<sup>10</sup> Typically, it presents with brief and recurrent episodes of vertigo caused by changes in the position of the head in relation to gravity. Lying down, getting up, and rolling on the bed are the most common vertigo triggers in BPPV.<sup>10</sup>

Benign paroxysmal positional vertigo is thought to be generated by free-moving otolith fragments dislodged from the utricular maculae. This debris can move freely inside the endolymphatic system, so it could migrate to any semicircular canal (canalolithiasis). In the typical canalolithiasis variant of BPPV, the free-floating particles within the lumen of the canal induce an aberrant signal from the semicircular canals, creating the illusion of motion, which results in vertigo along with nystagmus. Once the particles migrate down to the most dependent position of the affected canal, the nystagmus and vertigo cease (brief vertigo).<sup>11</sup>

The posterior semicircular canal variant is by far the most common variant of BPPV (80–90%). It has a typical nystagmus pattern (an upward and rotational-beating nystagmus) that appears on positional testing (Dix-Hallpike/modified Dix-Hallpike or side lying test).<sup>11</sup>

In lateral canal BPPV, the nystagmus is horizontal and changes its direction according to the side of the head on the supine roll test. According to the direction of the nystagmus relative to the ground during the head rotation, it can be geotropic or apogeotropic.

In the least frequent anterior canal BPPV, the nystagmus is downbeat-torsional, with the rotational component beating toward the affected side. The torsional component is not always present, being purely downbeating nystagmus in many cases. Note, however, that same direction nystagmus is equally observed in central lesions.<sup>11</sup>

Given the high prevalence of BPPV, its impacts are tremendous. The dizziness symptom is one of the most frequent complaints reported in doctors’ offices, and many of the people who suffer from it have BPPV as a cause.<sup>12-14</sup> This disorder of the vestibular system represented ~ 50% of the cases in a specialized ear, nose, and throat (ENT) clinic.<sup>15</sup> Similarly, in an emergency department (ED) setting, it was reported to be the second most common diagnosis, accounting for nearly 10% of emergency department (ED) dizziness presentations.<sup>16</sup>

In regular conditions, vestibular examination includes positional testing to BPPV, head thrust test, head shaking test, among others, all involving a close physical contact between the examiner and the patient. Due to COVID infection, those are currently considered unsafe for the vestibular clinic staff, including patients, physical therapist, and physician.

Teleconsultation and teletreatment consist in the application of technology to provide remote health services, digitally connecting the professional with patients/users, or the professional with other professionals, providing educational, preventive, diagnostic, or intervention health services.<sup>17-19</sup> It has attracted an exponential interest in the context of the COVID pandemic.

In view of the need for social isolation generated by COVID-2019 and the high prevalence of BPPV, it is necessary to reorganize the vestibular practice to a non-face-to-face paradigm, in order to reduce the risks of bidirectional contamination.<sup>17,18</sup> Although without personal presence, the healthcare provider/patient proximity is possible. Teleconsultation and teletreatment have shown efficacy similar to face-to-face assistance in pathologies such as stroke. Additionally, real-time virtual care at scale would free up time for health personnel to be used in patients who really benefit from the face-to-face consultation.<sup>20</sup>

The aims of the present study were; first, to propose a teleconsultation and teletreatment protocol to manage patients with BPPV during the COVID-19 pandemic; and second, to provide specific advices to the otoneurological evaluation and treatment in a remote consultation, through a simplified flowchart.

Clinical target: the guideline is intended for all clinicians who are likely to diagnose and manage patients with positional vertigo, and it applies to the teleconsultation approach, in which BPPV would be identified, monitored, or

managed. The target patient for the guideline is aged  $\geq$  18 years old with a suspected or potential diagnosis of BPPV.

## Methods

To establish the theoretical feasibility of teleconsultation in the diagnosis and treatment of BPPV in isolated patients due to a COVID crisis, an initial bibliographic review was performed. Specialists in the vestibular field met through remote access technologies in order to discuss the best strategy to manage BPPV patients by teleconsultation and teletreatment. It was supplemented through the reviewing of various scientific sources, including Lilacs, SciELO, and Medline by PubMed data, books, and specialized websites. The words *COVID-19*, *telemedicine*, *dizziness*, *vertigo*, *BPPV*, and *therapeutics* were included in the search strategy. The studies obtained through the search were ordered and classified according to their relevance in relation to the objective of the present study. For the technical issues related to the teleconference and telehealth system itself, the guidelines of specialist academies were also involved (American Academy of Neurology, American Academy of Otolaryngology-Head and Neck Surgery, and Brazilian Academy of Otorhinolaryngology and Cervical-Facial Surgery). The feasibility to perform the self-examination at home (including positional testing) assisted by a portable recording camera were also part of the analysis.

Although it was not formally a critical review, the studies revised were considered in the context to ask the following question: how to design a clinical protocol to manage patients with BPPV using teleconsultation and teletreatment strategy during the COVID-19 crisis? To design a flowchart, the published data were independently analyzed by the authors with large experience in seeing patients with BPPV.

## Result

Information about teleconsultation and teletreatment in otoneurologic, in vestibular medicine and in vestibular physiotherapy, in particular, is scarce. There was a substantial heterogeneity in terms of technologies used and outcome measures among those studies. According to the portable home technology, only studies from 1990 to 2020 were analyzed.

Overall, six original studies were finally selected for further analysis. Since only a few studies were selected, they are abstracted below. In one study, a patient's eye movements during teleconsultation were recorded by a sophisticated device and transmitted in real-time to the examiner. The posterior canal BPPV was reached through the side lying test, and the reposition self-maneuver was monitored. Successful results were observed with only one repetition.<sup>21</sup> Another research has shown the use of smartphones in the teleconsultation for the diagnosis of BPPV. The authors concluded that the images obtained by this portable equipment were satisfactory and useful to the diagnosis process.<sup>22</sup>

A research on health care was conducted in a resource-restricted, post-Katrina Hurricane South Louisiana. The authors claimed that telemedicine was a viable delivery model for neurotology care.<sup>23</sup> Another prospective study has shown that, overall, a diagnosis concordance between the on-site and remote ENT was observed in 95% of the cases.<sup>24</sup> However, synchronous (real-time) telemedicine for vestibular disorders with a socially accessible telecommunication device has not been reported up to now.<sup>24</sup>

A recent study using the patient's smartphone to record the nystagmus at the time of vertigo attacks resulted in a more accurate and faster diagnosis than the diagnosis based on subjective patient description of the symptoms in order to differentiate Meniere disease from other conditions.<sup>25</sup> Finally, a study presented positive results for the teletreatment of vestibular rehabilitation in chronic vestibular syndrome, similar to the face-to-face approach.<sup>26</sup>

## Discussion

Although with limited and indirect evidence, teleconsultation and teletreatment are probably safe and effective tools to assess dizzy patients and guide the patient's diagnosis and treatment procedure, minimizing the risk of COVID-19 spreading. However, most ENT specialists, neurologists, physiotherapists and otorhinolaryngologists are not familiarized with this novel method to manage their patients. Technical limitation and adapted physical examination must be considered. Benign paroxysmal positional vertigo patients represent a high prevalent subgroup of otological consultations, being the main target of the present study.

### Technical Issues and Limitations

Otoneurological teleconsultation requires a videoconferencing system, and portable telecommunication devices, such as tablets or cell phones with access to specific platforms, are commonly used. Encryption with applications with low privacy risks are recommended in both scientific and government guidelines.<sup>27-29</sup> However, policies and regulations on telehealth may vary between countries. They allow telepresence and to have an internet provider that offers a service with the minimum required quality. Publicly accessible image and sound transmission media, such as those offered on social networks, are not recommended. For archival purposes, future verification, professional or patient protection, a recordable application or platform should be considered.

Regulation by professional councils, ethics committees, or by an equivalent office is necessary, according to which each country and profession must approve the teleconsultation and teletreatment system in order to safeguard good clinical practice. However, in situations in which a pandemic is declared, certificates and policies for teleconsultation and teletreatment can be more flexible and complacent in order to prioritize the first care of acute patients. Irrespective of the policies applied, the informed consent for telehealth procedure must not be waived.

It may be necessary to deliver to the patient relevant information regarding the platform, the application, or other video communication resources just before the appointment with the healthcare provider.

**Examination Environment**

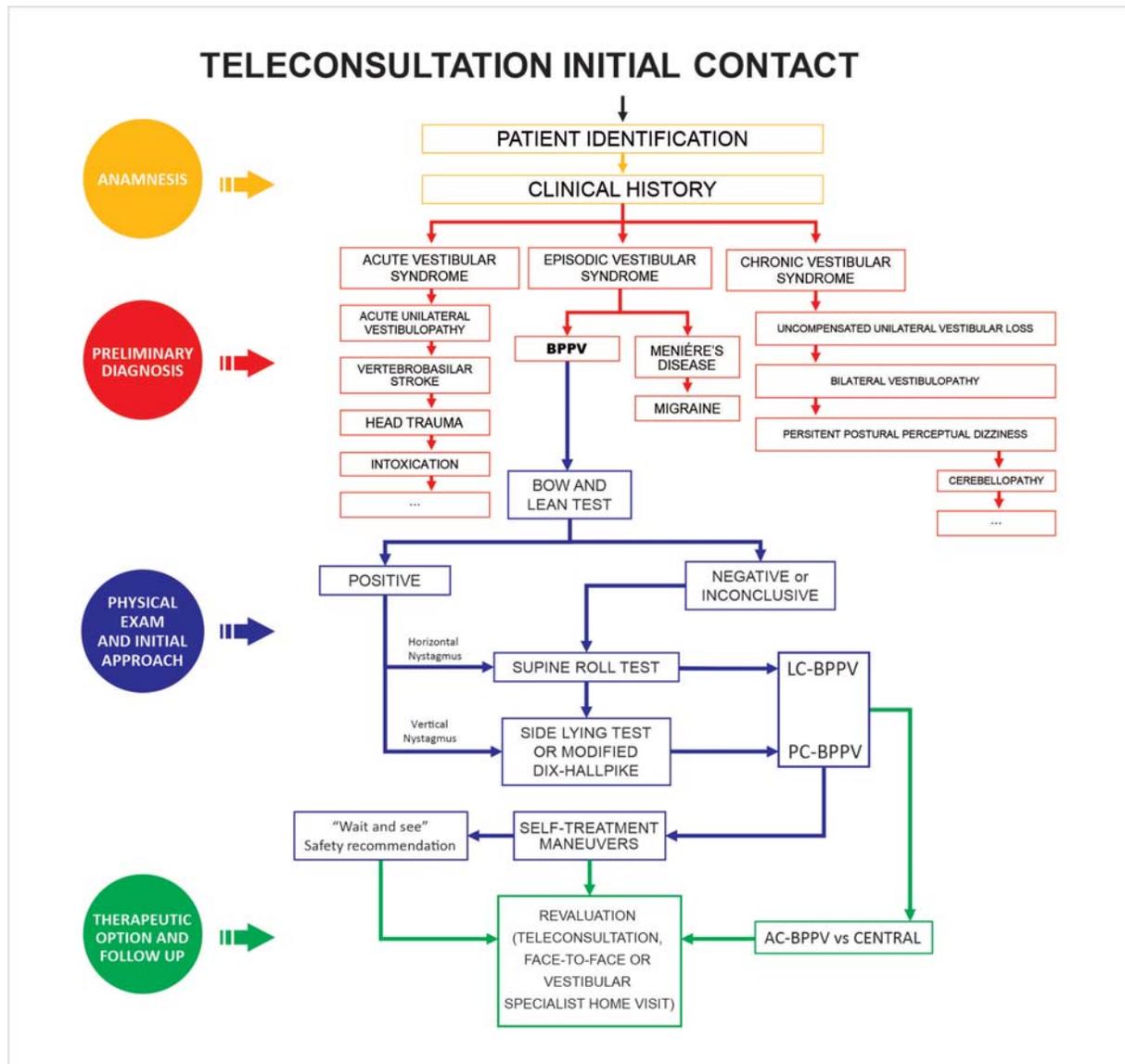
At the time of the teleconsultation, the presence of a family member, parent or independent examiner (nurse or caregiver) is recommended, not only to assist the patient along the procedures, following the guidelines, but also to maintain the patient’s safety and provide the first care in case of unexpected reactions. The patient should be hand-supported along the whole process. The patient should be instructed to record the video of his eyes with a cellphone, similarly as taking a selfie, keeping the eyes wide open during the procedure.

In addition to telecommunication equipment, an equivalent of an examination table may be required, and the patient’s bed is usually appropriate. A well and homogeneously illuminated room is required.

**Telediagnosis and Treatment Protocol Approach**

To drive the teleconsultation protocol, the procedures must be organized into different levels, as shown in ►Fig. 1. First, involve an initial contact with the patient and the assistant; a double way identification (i.e., name and birthday) is recommended. After the first contact, the teleconsultation consent is carefully taken. The advantages, disadvantages and limitations of remote consultation must be stated before any intervention. If a verbal consent was taken, it should be recorded in the patient’s clinical history or in equivalent reports.

The flowchart for the management of BPPV patients by remote service is displayed in ►Fig. 1. In capsule form, the clinical history includes anamnesis, physical examination, review of the medications list, preliminary diagnosis, treatment approach, and expected outcome, according to the flowchart of ►Fig. 1. The clinician begins to compile the clinical history, taking mainly into account the extensively used TiTRaTe approach, which emphasizes the importance of defining the time of onset and the duration of the symptoms,



**Fig. 1** Flowchart of otoneurological management for BPPV patients by means of teleassistance.

as well as whether it is possible to identify what triggers them (trigger). The TiTRaTe approach attempts to classify the set of symptoms into an acute, episodic, or chronic vestibular syndrome (► **Fig. 1**).<sup>30</sup>

The most representative conditions within the episodic vestibular syndromes include: BPPV, Meniere disease and vestibular migraine.<sup>31</sup> A differential diagnosis of orthostatic hypotension, panic, or cardiac arrhythmia may be required. In these cases, referral to a specific evaluation would be necessary.

**Level 1:** If the characteristics of the episodic vertigo are of short duration (seconds), sudden onset, paroxysm pattern, provoked by relative movements of the head (lying down, sitting, turning sideways), BPPV must be considered first. The typical subjective cluster of symptoms has shown a sensitivity of 95% and a specificity of 60% for BPPV diagnosis.<sup>32,33</sup>

Before a further positional evaluation, both spontaneous nystagmus and gaze evoked should be ruled out. After a few minutes at rest in a sitting position, the clinician should ask the patient to just look straight ahead with the eyes relaxed, then move them from 30° to 40° to the left, to the right, up and down.<sup>34</sup> The occurrence of underlying nystagmus at naked eye in any gaze position should alert to another diagnosis instead of BPPV. An adapted neurological examination for telemedicine setting has been already posted by the American Academy of Neurology.<sup>35</sup> Although the vestibular examination was not included, it results in an important tool to identify the additional central signs for the tele-diagnosis of central disorders.<sup>36</sup>

If BPPV is the preliminary diagnosis according to TiTRaTe, the evaluation begins with the bow and lean test (BLT) to support or not the diagnosis (► **Fig. 2**).<sup>37</sup> In the BLT, the patient is sitting on a chair or a sofa, and both the backrest and feet must be firm on the floor or on another surface, in order to provide more security and stability to the patient. The procedures consist of observing the occurrence of any new nystagmus during neck extension (facing the ceiling) and flexion (facing the floor). In the teleconsultation, the nystagmic activity is recorded on video along with the procedure so it can be observed remotely by the clinician. The assistant must hold the patient's shoulders during the maneuver.

The BLT was introduced to determine accurately the affected ear in patients with lateral canal BPPV at the bedside.

It is based on the direction of nystagmus when the patient's neck is flexed and extended, changing the orientation of the lateral canal in relation to gravity. In the canalolithiasis (geotropic) mechanism, the fast phase horizontal nystagmus indicates the affected ear when flexing the neck with the head facing down (flexion). On the other hand, in cupulolithiasis (apogeotropic), the horizontal nystagmus affects the affected ear in the extended neck with the head facing up position.<sup>38</sup> Subsequently, if an horizontal nystagmus is observed during the BLT, a more specific supine roll test needs to be performed in order to accurately identify the affected ear, as well as the mechanism involved (geotropic or apogeotropic variant) (see level 2).

Other studies expanded the evidence to the use of the BLT as a screening maneuver in order to identify the involvement of the vertical semicircular canals.<sup>39</sup> A nystagmus with fast phase beating up or down during a torsional movement observed in the BLT is consistent with BPPV of a vertical canal (posterior or anterior).<sup>39</sup> The vertical canal BPPV should be further confirmed with the side lying (or Dix-Hallpike) test, as described below (level 2).

An interval of 30 to 45 seconds is required in a neutral head position (facing straight ahead), and in each position (flexion and extension), in order to avoid false negatives due to the latency of the onset of symptoms typically observed in BPPV.<sup>32,40</sup> In symptomatic patients, a resting time between maneuvers could be necessary to let the vertigo and nystagmus subside.

**Level 2: progression assessment.** The BLT is specific but insensitive to BPPV.<sup>39</sup> In some cases, the nystagmus and vertigo are not observed during the BLT, in view of the insufficient angular amplitude of the flexion-extension movement of the neck to generate significant movement of otoconia pushed by the action of the gravity. The BLT will be positive for BPPV if the otoliths are large or numerous enough to create an endolymphatic flow displacement by the otoconia motion.<sup>39</sup> In cases with high clinical suspicion but negative BLT, the examination should be supplemented with the supine roll test. It starts with the body in supine position, and then turning the head 90° to either side.<sup>41</sup> This is also called the Pagnini-McClure maneuver (► **Fig. 3**).

If the nystagmus observed is horizontal on both sides with vertigo, it is consistent with lateral canal BPPV. Two typical forms of lateral canal BPPV have been recognized according



**Fig. 2** Bow and Lean Test procedure– Left to right: Straight ahead, flexion and extension of the head while the eyes movements are recorded with a cellphone. Each position should be maintained for at least 30 seconds according to the tolerance of the patient (adapted from the original)<sup>37</sup>



**Fig. 3** Supine Roll Test (adapted from the original) procedure. The patient lies supine on an examination couch. The subject turns his head 90° to either side, while the nystagmus is recorded. The head should be maintained for 45 to 60 seconds in each position. A slight elevation of the head from the table (~ 20°) (i.e head resting on the pillow), is recommended.<sup>38</sup>

to the nystagmus direction regarding the dependent ear. It can be geotropic (beating to the ground) or apogeotropic (beating to the ceiling).<sup>37-39</sup>

If both the BTL and the supine roll test are negative, vertical canal BPPV could still be possible. Consequently, the specific maneuver should be performed. The side lying test or the modified Dix-Hallpike test with a pillow placed behind the patient's back are recommended in the home-made BPPV examination (► **Fig. 4** and ► **Fig. 5**). Upward and rotational-beating nystagmus are observed in posterior canal BPPV, although the torsional component is almost always invisible to the portable device camera.<sup>39</sup> The most intense paroxysmal upbeat nystagmus and vertigo with the ear down is considered the affected ear.<sup>42,43</sup>

When the patient returns to the sitting position, the particles (otoliths) fall in the opposite direction of the posterior canal and cause a second episode of paroxysmal nystagmus and vertigo. This paroxysmal sitting up nystagmus and vertigo can occur just after any positional testing. Therefore, the patient and the assistance must be alerted about its occurrence.

An occurrence of downbeat nystagmus in any positional test suggests equally anterior canal BPPV or central lesion.<sup>44</sup> Therefore, the patients should be referred to a face-to-face or home consultation. If no vertigo or nystagmus are observed in any positional test, an active BPPV can be preliminarily ruled out.

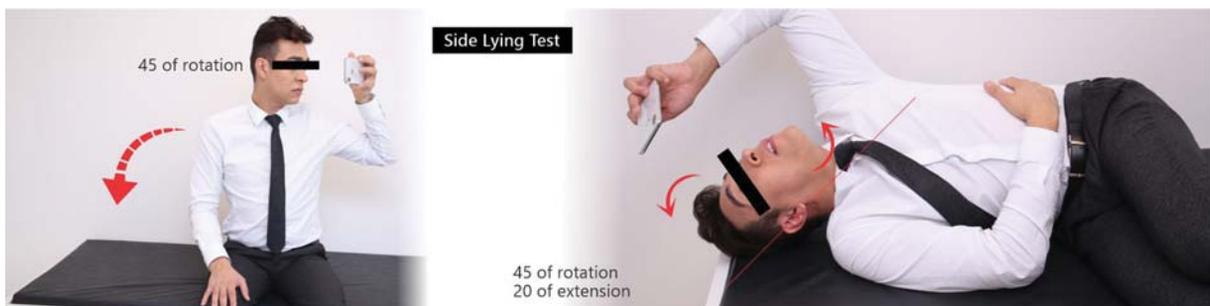
### Reasonability of BLT as a Home Screening Test

Teleassisted BLT is suitable to be performed by the patients themselves with the assistance of a family member or caregiver, while interacting with the clinician to receive instructions remotely in real-time. Although, with rare exceptions, a patient with congruent clinical history who reports typical vertigo and present with a nystagmus observed in the BLT, the most likely diagnosis is BPPV. A positive diagnosis of BPPV would reduce other potentially dangerous causes of vertigo, such as stroke, intoxicants, etc.

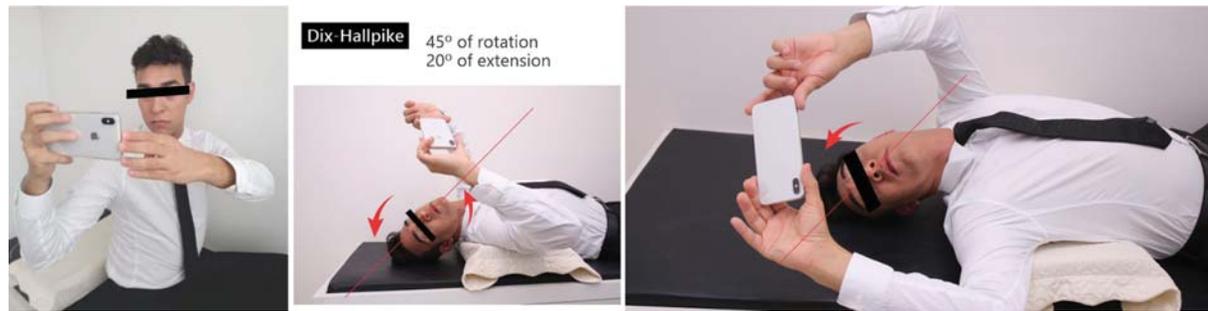
The logic of the BLT as the first option in the diagnosis stage of BPPV at home resides in its simplicity in being accomplished by the patient and by an unexperienced examiner, and in that it is easier to record the image of the eyes during the teleconsultation when approaching the camera to the patient's eyes.

When the BLT is positive for vertical canal BPPV, other tests, such as the Dix-Hallpike test or the side lying test, can be performed to determine the affected ear.<sup>42,45</sup> However, the examiner must explain to the patient and the assistant the further procedure, in order to consent and prevent any nonexpected reactions.

On the other hand, if the BLT is inconclusive, the examiner should perform other tests, such as the Dix-Hallpike test or side lying test and roll test to exclude the diagnosis of BPPV.



**Fig. 4** Side Lying Test (adapted from the original).<sup>45</sup> The patient sits sideways in the middle of an examination couch. The subject turns his/her head 45° away from the test ear and lies sideways so that they maintain the 45° head turn looking upwards toward the ceiling while the nystagmus is recorded. Bring the patients feet up onto the couch to be more comfortable. An external support (i.e caregiver) is commonly required.



**Fig. 5** Modified Dix Hallpike test procedure. Left picture: The patient's head is turned 45° toward the test ear. Then, he/she is brought from sitting to a supine position, with the head extended ~20° backward with the back resting on the pillow (middle picture). The patient should be instructed to fix his/her eyes on a point directly in front of him/her to let the nystagmus be recorded throughout the test (right picture) (adapted from the original)<sup>42</sup>

In case of difficulty in performing any positional testing, the examiner will be able to guide the patient to continue the evaluation in an outpatient setting or on-site at home, in order to establish ultimately the origin of positional vertigo and its treatment.

### Teletreatment options for BPPV

Emphasis on patient education and shared decision-making: once the BPPV diagnosis is established according to the symptoms and nystagmus observed in the single positional test, the treatment options can be discussed with the patient and his or her parents, including the risk and benefits of the repositioning maneuvers performed at home without a skilled assistant. Information that the BPPV is associated with a good prognosis must be discussed. This favorable prognosis, in part, is due to the fact that many cases of BPPV recover spontaneously in the period of 1 to 3 months.<sup>46,47</sup> If no active treatment ("Wait and See" strategy) is decided, certain modifications in daily activities and safety recommendations should be indicated (►Fig. 1).

If BPPV is diagnosed with the affected ear and the canal involved, the examiner can finally to guide the self-maneuver or to recommend a face-to-face assistance.<sup>48,49</sup> Home repositioning maneuvers or self-treatment maneuvers are particularly useful in patients with prior experience in BPPV and who are less apprehensive regarding its self-management (►Fig. 1). The DizzyFix device, or videoassisted maneuver, manufactured by Clearwater Clinical Limited (Calgary, Alberta, Canada), has shown its utility in facilitating repositioning at home.<sup>50</sup> Likewise, home self-management maneuvers are recommended in the American Academy of Otolaryngology – Head and Neck Surgery (AAOHS) guide for managing BPPV.<sup>42</sup>

### Conclusion

This teleconsultation and teletreatment protocol is a useful tool to healthcare professionals in the field of otoneurology for the management of patients with suspected BPPV in situations of difficult access to specialized services or of restricted circulation and limited social contact.

Although teleconsultation and teletreatment are associated with substantial weaknesses and technical issues, in non-life-threatening conditions (i.e., BPPV) and in the pandemic context, the benefits could be superior to the costs, especially in regions with high COVID circulation. Perhaps, its utilization could be tested in special cases of geographic barriers (climate catastrophes, earthquakes, and others) to access long-distance territories and in an already overloaded health system.

Specific studies are needed to measure validity, reliability and sensitivity of this instrument and its utility in different settings.

### Conflicts of Interest

The authors have no conflicts of interest to declare.

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