LAJOMS

Review

Benign paroxysmal positional vertigo in maxillofacial surgery: literature review

Vértigo posicional paroxístico benigno en cirugía maxilofacial: revisión de la literatura

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ABSTRACT

Introduction: benign paroxysmal positional vertigo (BPPV) is the main cause of vertigo of vestibular origin. Its etiology, among others, has been associated with dental procedures, and Maxillofacial Surgery. **Objective:** to present a review of the published literature on BPPV associated with dental and maxillofacial surgery procedures. **Material and methods:** an unfiltered search was performed in the PubMed, Science Direct and Google Scholar databases. Relevant articles that established an association between Benign Paroxysmal Postural Vertigo and Dental and Maxillofacial Surgery were included. When applying the search strategy, a total of 187 articles were found. After applying the inclusion, exclusion and elimination criteria, 159 articles were excluded. A total of 29 publications were included in this study. **Conclusion:** BPPV is characterized by the repetition of episodes of vertigo lasting seconds to minutes, triggered by changes in the position of the head. Its etiology related to dental procedures and maxillofacial surgery is related to prolonged position and the use of percussion and/or rotary instruments during procedures performed in the maxillofacial region. Therefore, it is essential that the Maxillofacial Surgeon recognizes the signs and symptoms of this condition.

RESUMEN

Introducción: *el vértigo posicional paroxístico benigno (VPPB) es la principal causa de vértigo de origen vestibular. Su etiología, entre otras, se ha asociado con procedimientos dentales y cirugía maxilofacial.* ***Objetivo:*** *presentar una revisión de la literatura publicada sobre el VPPB asociado a procedimientos de cirugía dental y maxilofacial.* ***Material y métodos:*** *se realizó una búsqueda sin filtros en las bases de datos PubMed, Science Direct y Google Académico. Se incluyeron artículos relevantes que establecían una asociación entre el vértigo postural paroxístico benigno y la cirugía dental y maxilofacial. Al aplicar la estrategia de búsqueda, se encontraron 187 artículos. Tras aplicar los criterios de inclusión, exclusión y eliminación, se excluyeron 159 artículos. Se incluyeron 29 publicaciones en este estudio.* ***Conclusión:*** *el VPPB se caracteriza por la repetición de episodios de vértigo que duran desde segundos hasta minutos, desencadenados por cambios en la posición de la cabeza. Su etiología, relacionada con procedimientos dentales y cirugía maxilofacial, se relaciona con la posición prolongada y el uso de instrumentos de percusión o rotatorios durante procedimientos realizados en la región maxilofacial. Por lo tanto, es fundamental que el cirujano maxilofacial reconozca los signos y síntomas de esta afección.*

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Introduction

Procedures performed in Oral and Maxillofacial Surgery involve the use of instruments capable of transmitting percussion and/or vibration forces into the labyrinth of the inner ear through adjacent bony structures. In addition, surgical procedures involving direct or indirect trauma to structures close to the middle ear. Such procedures may trigger benign paroxysmal positional vertigo (BPPV), as evidenced by case studies of third molar surgery, traumatic extractions, preprosthetic surgery, maxillary sinus elevation, fractures of the maxillary zygomatic complex, and Le Fort osteotomy in orthognathic surgery.[1,2]

The aim of this paper is to present a review of the published literature on BPPV associated with dental procedures and dental and maxillofacial surgery. This will allow the specialist to establish a diagnosis and initiate treatment in a timely

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manner. This should be complemented by vestibular rehabilitation exercises that help to reduce the risk of recurrence and improve the prognosis of these patients.

Benign paroxysmal positional vertigo (BPPV)

BPPV represents the foremost cause of positional vertigo of vestibular origin.[1] It manifests as brief, recurrent episodes of vertigo triggered by changes in head position,[2] such as when looking up, turning in bed, lying down or bending over,[3] which may precipitate nausea and/or vomiting and other vagal symptoms.

The lifetime prevalence of BPPV is estimated to be 2.4%, with an annual prevalence rate of 1.6% and an annual incidence rate of 0.6%.[4] In 34-66% of cases, no discernible cause is identified, thus classifying these as idiopathic or primary BPPV. The prevalence of BPPV is reported to be 2-3 times higher in women than in men, with a peak incidence in the sixth decade of life.[5] In contrast, it is considered to be acquired or secondary when the aetiology is related to inner ear disease, traumatic brain injury,[6] migraine, ear or dental surgery, prolonged bed rest, whiplash injury,[3] head and neck surgery or trauma,[4] sinus floor lift surgery with osteotome and orthognathic surgery.[2]

The aetiopathogenesis of benign paroxysmal positional vertigo (BPPV) has historically been attributed to cupulolithiasis (Schuknecht, 1969) or canalolithiasis (Hall et al., 1979).[5] In the case of cupulolithiasis, the remnants of the otoconia adhere to the cupula, resulting in the patient becoming gravity sensitive. In the case of canalolithiasis, the otoliths detach from the utricle and move into the lumen of the semicircular canal, causing movement of the endolymph, which in turn stimulates the affected canal and produces vertigo.[2,7] The two variants of BPPV include the posterior semicircular canal (PSC), which accounts for 60-95% of cases, the lateral semicircular canal (LSC), comprising 5-30%, and the superior semicircular canal (SSC) in 1%.[4] It most commonly occurs unilaterally, although it is estimated that 6-25% of cases occur bilaterally.[2,6,8,9]

Diagnostic criteria have been proposed by the Bárány Society Classification of Vestibular Disorders.[10]

The diagnosis is primarily established by clinical history and examination, and to confirm it, vertigo and characteristic nystagmus can be induced by the Dix-Hallpike and Pagnini-McClure manoeuvres.[2,4,8]

Diagnostic manoeuvres

Dix-Hallpike manoeuvre: Indicated for the diagnosis of PSC BPPV. The patient is positioned in a sitting posture with the head tilted 45º towards the ear to be assessed. They are then lowered to the supine position with the neck extended. The test is positive if nystagmus is present.[8,11,12] (The characteristics of nystagmus are summarized in *Table 1*).

The supine twist test is utilized for the diagnosis of LSC BPPV. The patient commences in a supine position with the head tilted at 30º. The head is then rotated 90º to one side and observed for nystagmus. The head is then returned to the supine position. If nystagmus is observed, the head is rapidly rotated 90º to the opposite side and observed for nystagmus.[8,11]

Therapeutic manoeuvres

The Epley and Semont manoeuvres are utilized in the treatment of PSC BPPV.

The Epley manoeuvre is regarded as the gold standard of treatment when the PSC is affected. It has been estimated that the success rate of the Epley manoeuvre is 80% at the first attempt and 92% after the fourth attempt for the treatment of posterior canal BPPV.[8,9] However, the reported success rate for cases involving LSC is estimated to range between 50 and 75% for cupulolithiasis and canalolithiasis, respectively *(Table 2)*.[13]

Table 1: Characteristics of nystagmus in diagnostic maneuvers.

	Dix-hallpike[8,12]	Roll test[8,12]	
Semicircular canal affected	Posterior canal BPPV	Lateral canal BPPV (canalolitiasis)	BPPV of the lateral canal (cupulolitiasis)
Type of nystagmus	Upward torsion towards the affected ear	Geotropic positional	Apogeotropic
Nystagmus latency	5-20 seconds	Short	No latency
Duration of nystagmus	< 1 minute	< 1 minute	> 1 minute
Nystagmus behavior	Fatigue when repeating the maneuver	Increases in intensity and then decreases	Does not decreased in intensity

BPPV = Benign Paroxysmal Positional Vertigo.

Table 2: Maneuvers used for the treatment of Benign Paroxysmal Positional Vertigo.[9,12]

Posterior canal	Lateral semicircular canal	Anterior semicircular canal
Epley	Lempert(barbecue)	Inverted epley
Semont	Gufoni	Yacovino
Gans	Li	-

The patient is initially positioned in a sitting stance with the head rotated 45º towards the affected (right) ear. They are then placed in a supine position with the head held at 45º and the neck extended slightly below the horizontal plane. The patient is maintained in this position until the provoked nystagmus has ceased, at which point the head is rotated 90º towards the unaffected ear and held in this position until the provoked nystagmus has resided. The patient's body is then rotated 90º towards the unaffected side while the head is rotated a further 45º and held in this position until any provoked nystagmus has ceased. Finally, the patient is returned to a sitting position, with the head neutral.[8,12,13]

Semont manoeuvre

The patient is positioned in a seated posture with the head oriented at a 45º angle towards the unaffected ear. Subsequently, the patient is gently descended onto the lateral side of the affected ear, where they are maintained in a lateral decubitus position for a duration of one minute. While preserving the initial head position, the patient executes a swift 180º rotation to assume a lateral recumbent posture, which is sustained for one minute. The patient is then returned to a seated position, with the head in a neutral position.[8,12] The Semont-Plus manoeuvre was proposed by Strupp et al., based on a biophysical model and computer simulations.[14]

Lempert manoeuvre (Barbecue)

This manoeuvre is employed in the treatment of LSC BPPV. The patient commences in a supine position and rotates the body 90º towards the affected side. Subsequent to 30 seconds, the patient rotates back to the supine position. Thereafter, the patient rotates the body in the same direction in 90º increments until the body has been rotated 270º. At this juncture, the patient returns to the upright, sitting position.[2]

It is noteworthy that recurrence has been documented in up to 20% of cases during the initial year, 44% during the first two years, and up to 50% at 5-10 years of follow-up.[4,9,13]

It is estimated that 10-20% of patients remain affected after multiple attempts at treatment with repositioning manoeuvres.[14] This has led to the development of mechanical repositioning chairs which allow complete control of the speed and angles of movement while the patient remains in a fixed position.The use of these devices is complemented by videonystagmography equipment for accurate assessment of nystagmus.[15,16] The utilisation of these devices has yielded a 66 to 100% success rate, while the estimated recurrence rate has been documented as 25%.[17]

Material and methods

Search strategy: an unfiltered search of PubMed, Science Direct, Google Scholar and Scielo databases was conducted on 10 August 2023 with the following search terms: «Benign Paroxysmal Positional Vertigo» AND «Oral and Maxillofacial Surgery» OR «Dental Procedures».

The inclusion criteria were met by articles that established a connection between Benign Paroxysmal Positional Vertigo (BPPV) and dental, oral and maxillofacial surgery procedures. The exclusion criteria included articles published in languages other than English or Spanish, cases associated with cochlear implant surgery, imaging studies and patients with spinal cord injuries. The elimination criteria were studies that received letters to the editor or retraction during article completion.

The selection of studies is summarized in *Figure 1*, which shows that the application of the search strategy resulted in the identification of 187 articles. The following were excluded by title: duplicate articles, studies that were not considered relevant to the objective of this study and those that presented any exclusion criteria. A total of 141 articles were excluded. 46 abstracts were peer reviewed, and 17 studies were excluded as follows: eight studies presenting insufficient diagnostic information, seven imaging studies, two studies performed

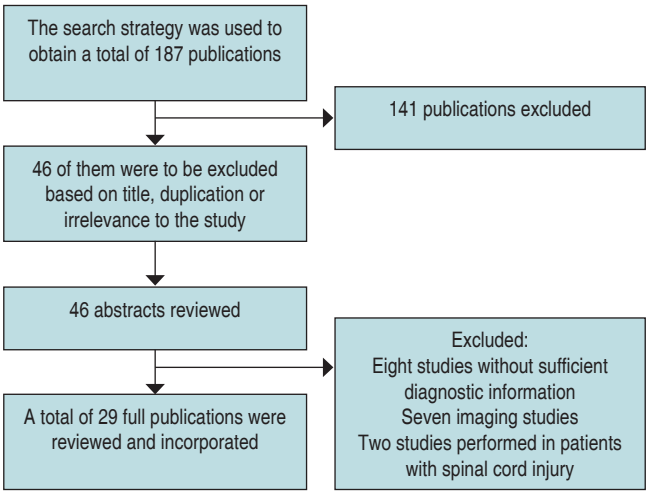

Figure 1: *Flowchart of the selection of articles included in this study.*

Table 3: Case series associating BPPV with oral and maxillofacial surgery procedures.

Article	Type of article	Sample	Procedure	Diagnosis of BPPV	Latency
Di Girolamo, 2005.[20]	Retrospective	146	Maxillary sinus lift using Summers technique	4	1-2 days
Saker, 2005.[26]	Case report	1	Maxillary sinus floor elevation with closed technique	1	Immediate postoperative
Chiarella, 2007.[22]	Retrospective	8	Extraction of third molars (6) Mandibular cyst (1) Implant (1)	6 PSC unilateral	Average 4.8 days (One patient in 8 hours) Four days One day
Vernamonte, 2010.[27]	Case report	1	Maxillary sinus floor elevation with immediate placement of dental implant	Cupulolithiasis of the right PSC	Immediate postoperative
Sammartino, 2011.[19]	Triple-blind randomized controlled trial	196	Closed maxillary sinus lift with osteotome and hammer (98) With screwable osteotome (98)	Osteotome and hammer (3) Screw-in osteotome (0)	1-2 days -
Crovetto, 2012.[18]	Retrospective	76	Extractions and implants in the maxilla	1 CSP unilateral (Implant)	One day
Beshkar, 2013.[2]	Prospective	50	Le Fort I osteotomy (22) Le Fort 1 osteotomy and OSBM (28)	1 (Le Fort I y BMO)	Two days
Kim, 2013.[1]	Case report	1	Le Fort I osteotomy, OSBM and malar reduction	1	Three days
Al-Almaie, 2013.[24]	Retrospective	60 (79 procedures)	Maxillary sinus lift with osteotome (48) and lateral window (31)	Maxillary sinus lift with osteotome (48)	Dizziness accompanied by nausea immediately after the procedure (disappears after two to four weeks)
Akcay, 2015.[28]	Case report	1	Sinus floor elevation with osteotome	1	Immediate postoperative
Deniz, 2017.[7]	Prospective	23	Le Fort 1 osteotomy	3	-
Petrocelli, 2019.[23]	Retrospective	281	Bimaxillary orthognathic surgery (95) Extraction of teeth 3.8 and 4.8 (160) Maxillary sinus elevation (26)	4 bilateral 3 unilateral 11 bilateral 3 unilateral	3.61 days (average)
Atali, 2022.[29]	Retrospective	138	Indirect maxillary sinus lift	4	Between one and six weeks
Bashir, 2022.[25]	Case report	2	Surgical treatment of mandibular angle fracture (1) Conservative treatment of mandibular angle fracture	2	7-10 days

BMO = Bilateral Mandibular Osteotomy. BPPV = Benign Paroxysmal Positional Vertigo. PSC = Posterior Semicircular Canal.

in patients with spinal cord injury. A total of 29 publications were included in this study.

Discussion

Dental and maxillofacial procedures carried out in a dental chair require a variety of positions, with patients sometimes moving from an upright to a supine position with varying degrees of hyperextension and rotation of the head, especially during upper jaw procedures.[2,18,19] This predisposes to the displacement of otoliths, which triggers BPPV. A similar association has been observed in maxillofacial surgical procedures, such as the surgical extraction of impacted teeth, sinus lift, and Le Fort I osteotomy performed during

orthognathic surgery, which involve the use of osteotomes, percussors, saws, and burs.[2,7] It has been hypothesised that the energy generated by these instruments can be transmitted to the labyrinth of the inner ear. This, in conjunction with the patient's position, can result in the displacement of otoliths, a condition that predisposes the patient to BPPV.[2,7,20]

BPPV and dental procedures

Chang et al., conducted a case-control study involving 768 patients diagnosed with BPPV and 1,536 controls. The study revealed that 9.2% of patients with BPPV had received dental treatment within one month prior to diagnosis, in contrast to only 5.5% of individuals in the control group. This finding underscores a positive correlation between recent exposure to dental procedures and BPPV (odds ratio [OR] 1.77; 95% confidence interval [CI] 1.27–2.47).[21] A study conducted in Spain in 2012, which included 559 patients, reported that 1.7% (1 0 patients) reported a fear of experiencing vertigo when placed in the Trendelenburg position *(Table 3)*.[18]

BPPV and dental surgery procedures

Chiarella et al., selected patients with a diagnosis of BPPV over a 33-month period, in whom symptoms began after dental surgery. The sample consisted of eight patients. The mean onset time was 4.1 days. The quickest onset was recorded eight hours later, and the latest at seven days.[22] Petrocelli et al., conducted a retrospective study that included 281 patients divided into three groups: one of these groups consisted of 160 patients treated with extraction of teeth 3.8 and 4.8, in which ipsilateral vestibular pathology was demonstrated in three patients and bilateral in 11 patients. The earliest onset was reported in a 60-year-old female patient, occurring eight hours after the procedure, while the most remote onset occurred in a 68-year-old female patient, seven days later.[23] In both studies, follow-up was conducted at three, six, and 12 months after treatment using repositioning manoeuvres, with no recurrences reported.[22,23]

BPPV in orthognathic surgery

In a retrospective study of 95 patients who underwent orthognathic surgery, Petrocelli et al., reported bilateral involvement with multiple semicircular canals in two women and two men who underwent bimaxillary orthognathic surgery.[23] In a prospective study, Beshka and colleagues examined 50 patients, 22 of whom underwent Le Fort I osteotomy and 28 underwent Le Fort I osteotomy and bilateral sagittal split osteotomy of the mandible. The study reported that 31 patients experienced episodes of vertigo, although only one patient met the criteria for a diagnosis of BPPV, resulting in a longer hospital stay.[2] In another prospective study, Deniz and colleagues reported that, of 23 patients who underwent Le Fort I osteotomy, three were diagnosed with BPPV; two of these patients recovered without intervention, while the third required treatment using the Epley manoeuvre.[7] In a separate report, Hong Kim et al., described a case of bilateral BPPV in a 22-year-old female patient who underwent bimaxillary orthognathic surgery involving zygomatic reduction. The patient was treated with the Epley manoeuvre, which resulted in a successful resolution of the condition.[1]

BPPV in sinus lifts

Di Girolamo (2005) and Sammartino (2011) reported that, when performing the Summers technique, screw osteotomes and/or percussors transmit vibrations that can dislodge otoliths. Di Girolamo et al., investigated the correlation between BPPV and surgical trauma in a study of 141 patients, of whom two experienced severe rotational vertigo one day after surgery and two experienced dizziness that evolved into positional rotatory vertigo. When performing the Dix-Hallpike maneuver, all four patients reported contralateral rotatory vertigo to the implanted side.[20] Sammartino et al., compared the use of two types of osteotomes for sinus lift, in which 196 patients were included. The prevalence of BPPV was 3.0. 6% and no cases were reported with the use of a screw osteotome.[19] Al-Almaie et al., reported using a questionnaire that 100% (48) of patients undergoing sinus lift with an osteotome presented with dizziness and nausea immediately after the procedure, with resolution in 2-4 weeks. Conversely, no patient treated with a lateral window approach (31 procedures) presented symptoms.[24] Petrocelli et al., reported in their study that of the group of 26 patients in whom sinus lift was performed for implant preparation, three of them presented vestibular pathology.[23]

BPPV and mandibular fractures

Bashir et al., reported two cases of BPPV associated with mandibular fractures. The first case involved a 32-year-old male who slipped and fell, striking the right side of his face. A CT scan revealed a fracture of the right mandibular body, which was treated with open reduction and internal fixation. Ten days post-discharge, the patient presented with rotatory vertigo upon changing positions in bed. The second patient was a 29-year-old female who sustained a fracture of the left mandibular body in a motor vehicle accident. She underwent conservative treatment and reported episodes of vertigo when changing positions in bed seven days' post-discharge. The Dix-Hallpike manoeuvre was utilized for diagnosis, and treatment in the form of repositioning maneuvers was administered, resulting in the complete resolution of symptoms.[25] Traumatic brain injury has been identified as a causative agent for

both maxillofacial complex fractures and BPPV, thereby indicating the potential for concurrent occurrence of these two complications.

Conclusion

BPPV is characterized by recurrent episodes of vertigo triggered by changes in head position. It has been linked to dental and maxillofacial procedures due to positional changes and the use of surgical instruments that generate vibrations capable of inducing this type of vertigo. Consequently, it is imperative for maxillofacial surgeons to possess a comprehensive understanding of the signs and symptoms associated with this condition, as early diagnosis and treatment, facilitated by repositioning maneuvers, can significantly enhance outcomes.

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