Guo Z et al. (2024) EVALUATING THE EFFICACY OF PETROSAL AND CEREBELLOPONTINE FISSURE APPROACHES FOR MICROVASCULAR DECOMPRESSION IN ATHLETES WITH TRIGEMINAL NEURALGIA. Revista Internacional de Medicina y Ciencias de la Actividad Física y el Deporte vol. 24 (98) pp. 210-226.
DOI: https://doi.org/10.15366/rimcafd2024.98.014

ORIGINAL

EVALUATING THE EFFICACY OF PETROSAL AND CEREBELLOPONTINE FISSURE APPROACHES FOR MICROVASCULAR DECOMPRESSION IN ATHLETES WITH TRIGEMINAL NEURALGIA

Yuanjie Zhang[1], Zhihua Cheng[1], Wei Shi[1], Chen Shen[1], Zhilin Guo[1,*]

[1] Department of Neurosurgery, Shanghai Ninth People's Hospital, Affiliated to Shanghai Jiao Tong University School of Medicine, Shanghai 200011, China.
E-mail: gzlysr@126.com

Recibido 14 de enero de 2024 **Received** January 14, 2024
Aceptado 14 de septiembre de 2024 **Accepted** September 14, 2024

ABSTRACT

Background: Trigeminal neuralgia (TN) presents a significant challenge for athletes, where neuropathic pain can severely impact performance and quality of life. Microvascular decompression offers a potential cure, and novel surgical approaches such as the petrosal and cerebellopontine fissure methods have shown promising results. However, their effectiveness specifically in athletes requires further evaluation. **Objective:** This study aims to assess the effectiveness of the petrosal and cerebellopontine fissure approaches in complex microvascular decompression of TN in athletes, focusing on surgical outcomes and recovery quality. **Methods:** From August 2020 to August 2022, 90 athletes diagnosed with TN were randomized into two groups: a control group (n = 45) treated via the conventional bone flap approach and an observation group (n = 45) undergoing surgery through the cerebellar petrosal and venous space approaches. Metrics compared included operation time, hospital stay, intraoperative blood loss, preoperative and postoperative pain levels, sleep quality, pain-associated factors, serum inflammatory markers, and postoperative complications. **Results:** The observation group showed a significantly higher treatment efficacy rate of 95.56% compared to 84.44% in the control group. Notably, the observation group experienced shorter operation times, less intraoperative bleeding, fewer surgical adjustments, and a lower incidence of cerebellar contusions (all $P < 0.05$). Improvements in digital pain scale (NRS) and Pittsburgh Sleep Quality Index (PSQI) scores were more pronounced in the observation group at intervals post-surgery ($P < 0.05$).

Additionally, reductions in inflammatory markers such as IL-6, hs-CRP, and TNF-α were significantly greater in the observation group, aligning with lower postoperative complication rates of 4.44% compared to 17.78% in the control group ($P < 0.05$). **Conclusion:** The petrosal and cerebellopontine fissure approaches in microvascular decompression for TN are particularly beneficial for athletes, offering superior outcomes with reduced surgical impact and enhanced recovery. These techniques not only mitigate the immediate surgical risks but also support quicker resumption of training and competition by effectively managing pain and minimizing inflammatory responses post-surgery. This study advocates for a tailored surgical approach that considers the unique needs of athletes facing neuropathic conditions like TN.

KEYWORDS: Cerebellar petrosal fissure; Vein; Surgical approach; TN; Microvascular decompression

1. INTRODUCTION

Trigeminal neuralgia (TN) is a debilitating neuropathic pain disorder characterized by sudden, severe, electric shock-like pains predominantly in the areas of the face served by the trigeminal nerve (Abd-Elsayed et al., 2022). This condition poses a particular challenge to athletes, whose performance and training regimens can be severely disrupted by the unpredictable pain episodes associated with TN (Allam et al., 2023; Alwardian et al., 2021). Traditional treatment methods include pharmacological management, but for many, surgical intervention becomes a necessity when medications fail to control the pain or cause intolerable side effects (Araya et al., 2020; Bendtsen et al., 2019). Microvascular decompression (MVD) is a neurosurgical procedure that has gained acceptance as a definitive treatment for TN, particularly in cases where vascular compression of the trigeminal nerve is evident (Bendtsen et al., 2020; Chandra, 2022). The procedure involves surgically opening the cranium to access and decompress the nerve, often by inserting a small pad between the nerve and the offending vessel. However, the complexities of this procedure are magnified in athletes, whose optimal physical and neurological health is crucial for their professional and personal livelihoods. In recent years, advancements in surgical techniques have led to the development of the petrosal fissure and cerebellopontine fissure approaches for MVD (Cruccu et al., 2020; Di Carlo et al., 2022). These approaches aim to provide better access to the trigeminal nerve and offending vessels with potentially reduced risks and complications (Di Stefano et al., 2019; Edwards & Shaw, 2021; M. Gupta et al., 2022). By minimizing brain retraction and improving the surgical field's visibility, these methods may preserve nerve integrity and reduce the likelihood of intraoperative and postoperative complications, which is particularly important for athletes who need to return to peak condition as swiftly as possible (Jones et al., 2019; Lambru et al., 2021). However, despite these advancements, there remains a significant gap in clinical studies specifically investigating the outcomes of these innovative surgical approaches in the athlete population. Athletes not only require relief from pain but also need to ensure that their motor functions, sensory capabilities, and overall neurological health are maintained to continue their sports careers (Maarbjerg & Benoliel, 2021; Mizobuchi et al., 2021; Shulev et al., 2020). This study aims to fill this gap by comparing the traditional and newer surgical approaches in terms of effectiveness, safety, and the impact on postoperative recovery in athletes. The importance of this research lies not only in improving the clinical outcomes of athletes undergoing MVD for TN but also in advancing our understanding of how surgical innovations can be tailored to meet the specific needs of this unique population. By focusing on the specific challenges and recovery metrics important to athletes, this study provides valuable insights that can guide future surgical practices and rehabilitation protocols, ensuring that athletes can resume their professional activities with minimal disruption and optimal health post-surgery.

2. Patients and Methods

2.1 General Information

The databases such as CNKI, Wanfang, PubMed, Ovid and MEDLINE from August 2020 to August 2022, 90 patients with TN were randomly divided into observation (n = 45) and control (n = 45) groups. The operation was performed through the conventional bone flap approach in the control group and through the cerebellar petrosal fissure and venous space approach in the observation group. In the observation group, there were 18 men and 27 women, aged from 60 to 71 years, with an average of (63.43 ± 5.81) years. The course of the disease ranged from 1 to 8 years, with an average of (5.16 ± 1.42) years. And body mass index (BMI) was from 17.25 to 27.86kg/m^2 was (mean = 23.38 ± 4.21) kg/m^2. In the control group, there were 20 men and 25 women, their age ranged from 59 to 73 years, with an average of (61.89 ± 6.07) years. The course of disease ranged from 1 to 7 years (mean 5.72 ± 1.81) years. BMI was from 17.20 to 27.92kg/m^2 (mean = 23.33 ± 4.16) kg/m^2. No remarkable difference was found in general data ($P > 0.05$), as shown in Table 1. An informed consent form was provided to all patients as part of this trial, which was approved by the Medical Ethics Committee at our hospital.

(1) all patients were diagnosed by craniocerebral imaging examination (CT or MRI), and the clinical symptoms were in accordance with the diagnostic criteria of primary TN (Bendtsen et al., 2020) and complex micro vessels (Puleri & Randles, 2022); (2) all patients met the indications of MVD (the examinations indicated that the responsible vessels oppressed the nerve root, the trigeminal nerve was not clear and curved, the effect of drug treatment was poor, and other treatments failed); (3) all the patients were ≥ 18 years old with good cognitive ability; (4) Informed consent forms for all tests were signed voluntarily by the patients.

Exclusion criteria: (1) NT was caused by other factors; (2) patients with craniocerebral benign and malignant tumors or other severe somatic or mental diseases; (3) patients without follow-up observation or incomplete clinical data; (4) patients participated in other clinical researchers at the same time. Calculation formula of sample size:

$$n_1 = \frac{\left[z_{\alpha/2}\sqrt{p(1-p)(1+c)/c} + Z_\beta\sqrt{p_1(1-p_1) + p_2(1-p_2)/c}\right]^2}{(p_1-p_2)^2}$$

The bilateral α is 0.05, β is 0.2, and the therapeutic effect (total effective rate) is taken as the effect index. The parameters are set as P1=0.98, P2=0.78. After calculation, the sample size of each group was 41 cases, and the shedding rate was 10%. The two groups each included about 45 patients with a total of 90 patients.

2.2 Treatment Methods

The control group places the patient in the lateral position as the surgical position. The MVD is performed by taking a suboccipital posterior occipital approach, making a curved surgical incision in the skin of the transverse sinus, cutting the corresponding tissue layer by layer, severing the occipital arteries and veins, and carefully peeling the periosteum, ranging from top to bottom, taking care to completely expose the stellate, and in the lower part, depending on the position of the stellate, up to below the inferior line. The surgeon performed the craniotomy in the lower part of the skull. First, the milling instrument was selected to mill the patient's skull tissue, taking care to completely expose the lateral inferior border of the transverse sinus and the posterior border of the sigmoid sinus before forming a bone window and then carefully cutting the dual tissue. After the slow release of cerebrospinal fluid, the patient's cerebellar chorionic tissue and trigeminal nerve were fully exposed, and the trigeminal nerve was completely released. In the observation group, the lateral recumbent position was taken under general anesthesia, the mastoid root of the affected side was located at the highest point. The retro-auricular hairline oblique incision was about 6cm, and the routine retro-sigmoid free bone flap 2.0cm × 2.5cm exposed the intersection of transverse sinus and sigmoid sinus. The cerebrospinal fluid was slowly absorbed and the cerebral pressure dropped to focus the microscope on the cerebellar flap fissure above the facial auditory nerve. The anterior cerebellar vein and some branches of the cerebellopontine fissure gradually converged to form the cerebellopontine vein (CFV). The vein was attached to the surface of the single cerebellar lobule and passed upward through the upper limb of the cerebellopontine fissure, continuing into the trunk of the superior petrosal vein, and converging into the superior petrosal sinus. Where the epiglottic vein converges into the epiglottic sinus, the beginning of the CFV and the single lobe of the cerebellum were rotated inwards and upwards to expose the trigeminal nerve. When the cerebellar lobule or choroidal bulb was atrophied, the subarachnoid space was wide, the CFV or superior petrosal vein was elongated, and the angle of rotation was large, the CFV and cerebellar lobule continued to be rotated inward and upward, and the trigeminal nerve could be exposed to the REZ through the lateral gap of the CFV. On the contrary, when the subarachnoid space was narrow, the cerebellum was full, the CFV or superior petrosal vein was short and rotatable, or the responsible vessels were mainly located at the head end of the trigeminal nerve, REZ should be exposed through the medial or intermediate space of the CFV. The arachnoid adhesion was sharply separated between the beginning of CFV and the single lobule, and the CFV and the single lobule were moved away until it was close to the dual anchor of the petrosal vein. In most cases, the medial cerebellar peduncle vein (MCPV) ascending into the superior petrosal vein could be seen. At this point, the REZ in the upper limb of cerebellopontine fissure could be exposed through the medial venous space (the medial side of CFV and MCPV, the lateral side of single lobule). When MCPV converged into CFV earlier, there was no MCPV in the upper limb of cerebellopontine fissure, and it was also classified into medial space. In a few cases, MCPV was close to the lateral middle peduncle of the cerebellum and did not affect the exposure of REZ. REZ could be exposed through the intermediate space (medial side of CFV, lateral side of MCPV and single lobule). Sometimes it was necessary to use multiple spaces to deal with trigeminal nerve multi-vascular compression or single-vessel multi-regional compression. All vessels in contact with the trigeminal nerve that were larger than 1mm in diameter were removed with decompression pad cotton to achieve as much non-contact decompression as possible.

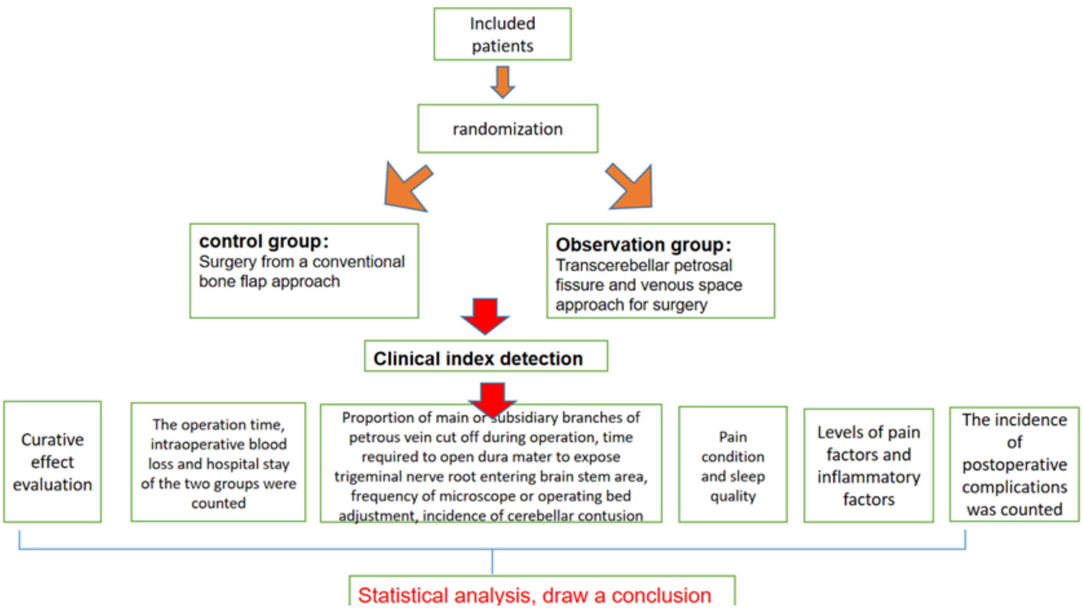

Figure 1: Technology Roadmap

2.3 Observation index

The main results were as follows: (1) CT was reexamined immediately after operation, and MRI was reexamined after weeks of operation, and the operative effect was evaluated according to postoperative imaging examination and intraoperative conditions. According to the criteria for judging the efficacy of Brisman in the treatment of TN (Singh et al., 2021), cured was defined as complete disappearance of postoperative pain; efficacious was defined as >90 percent postoperative pain relief with occasional medication; effective was defined as mild pain relief or ≥50% reduction in medication dose and multiple pains with only a single postoperative pain; and ineffective was defined as no postoperative pain relief. Total effective rate = (cured cases + extremely effective cases + effective cases) / total cases × 100%. (2) Operative time, intraoperative blood loss and length of stay in hospital for both groups. Intraoperative blood loss (g) = clean all the gauze weight-dry gauze weight (g), 1hr 1ml. (3) The proportion of patients in the two groups who cut the main trunk or branches of the petrosal vein, the time taken to open the dura to expose the trigeminal roots into the brainstem area, the number of microscopic or surgical bed adjustments, and the incidence of cerebellar contusions were observed and compared (Mason et al., 2022).

(4) Pain and sleep quality. Numerical Rating Scale (NRS) was used to evaluate patients' pain before treatment and 3, 7, 14 and 21 days after treatment (Serner et al., 2022). The total score was from 0 and10, and there is more pain with a higher score. To assess the quality of sleep of patients, the Pittsburgh Sleep Quality Index (PSQI) was used, with a score ranging from 0 to 21 (Denison et al., 2021). A higher score indicates a poorer quality of sleep. (5) The levels of pain factors and inflammatory factors. Before and 14 days after treatment, the fasting venous blood were collected and sent to the laboratory for centrifugation (velocity 3000r/min for 10min). The plasma levels of SP, PGE2, β-EP, IL-6, hs-CRP and TNF- α were measured by enzyme-linked immunosorbent assay (Elisa) with Mindray BS-800 automatic biochemical analyzer. We used a kit provided by Beijing Kexing Biological Products Co., Ltd., and followed the instructions carefully.

(6) Complications such as intracranial hematoma, cranial nerve paralysis, subcutaneous effusion, intracranial infection, and cerebrospinal fluid leakage were recorded in detail for all patients over the course of two months. The total incidence of complications = the sum of the number of all kinds of complications/the total number of cases × 100%. An intracranial hematoma was formed when blood collects in the brain or between the brain and the skull after a rupture of a blood vessel in the brain or between the brain tissue and the skull due to trauma, for example, and compresses the stroke. Cranial nerve palsy was caused by a lesion such as basal meningitis, which affects the third pair of cranial nerves arising from the skull. Subcutaneous effusion was mostly after

puncture treatment of fluid in the body cavity, resulting in fluid leakage into the subcutaneous soft tissue space due to high pressure in the body cavity. Intracranial infection referred to the microbial infection of the brain or meninges, the more common were brain abscess and intracranial tuberculosis.

2.4 Statistical analysis

A statistical program called SPSS22.0 was used to analyze and process the data. A ($\bar{x}$±s) symbol is used to indicate measurements with a normal distribution or approximate normal distribution. Comparing the two groups was done using paired t-tests, while comparing the two groups separately using independent sample t-tests. The n (%) was adopted to represent the counting data, and χ 2 test was adopted. P < 0.05 was the differences were statistically remarkable.

3. Results

3.1 Comparison of General Data

No remarkable difference was found in sex, age, course of disease and responsible artery (all P>0.05). The results of the study are listed in Table 1.

Table 1: The two groups of general data

GROUP	N	GENDER (MALE / FEMALE)	AGE (YEARS)	COURSE OF DISEASE (YEAR)	BMI INDEX (kg/m^2)	RESPONSIBLE ARTERY		
						ON THE CEREBELLUM	SUB-CEREBELLAR	ARTERIOVENOUS MIXING
OBSERVATION GROUP	45	18/27	63.43 ±5.81	5.16±1.42	23.38±4.21	18(40.00)	20(44.44)	7(15.56)
CONTROL GROUP	45	20/25	61.89 ±6.07	5.72±1.81	23.33±4.16	16(35.56)	23(51.11)	6(13.33)
T/X²		0.182	1.229	1.633	0.057	0.404		
P		>0.05	>0.05	>0.05	>0.05	>0.05		

3.2 The Clinical Efficacy

In the observation group, 18 people were cured, 12 people were extremely effective, 18 people were effective, 2 people were ineffective, and the total rate of treatment was 95.56%. In the control group, 12 people were cured, 13 people were extremely effective, 13 people were effective, 7 people were ineffective, and the total effective rate was 84.44% (P < 0.05). The results of the study are listed in Table 2.

Table 2: The therapeutic effects（n/%）

GROUP	N	HEAL	REMARKABLE EFFECT	EFFECTIVE	INVALID	TOTAL EFFICIENCY（%）
OBSERVATION GROUP	45	18 (40.00)	12 (26.67)	18 (40.00)	2 (4.44)	43 (95.56)
CONTROL GROUP	45	12 (26.67)	13 (28.89)	13 (28.89)	7 (15.56)	38 (84.44)
X^2						3.374
P						<0.05

3.3 The Hospitalization Time, Operation Time and Intraoperative Blood Loss

The operation time in the observation group was remarkably shorter, and the amount of intraoperative bleeding in the observation group was remarkably less ($P < 0.05$).

No remarkable difference was found in the length of stay ($P > 0.05$).

Table 3: The hospitalization time, operation time and intraoperative blood loss（$\bar{x}$±s）

GROUP	N	OPERATION TIME (MIN)	INTRAOPERATIVE BLOOD LOSS (ML)	HOSPITALIZATION TIME (D)
OBSERVATION GROUP	45	108.39±10.05	13.05±3.28	12.42±2.01
CONTROL GROUP	45	127.04±11.73	16.73±4.09	12.45±2.04
T		8.099	4.709	0.070
P		<0.05	<0.05	>0.05

3.4 The Intraoperative Observation Indexes

The proportion of cutting off the trunk or branches of petrosal vein during operation in the observation group was remarkably lower, the adjustment number of microscope or operation bed was less, and the incidence of cerebellar contusion during operation in the observation group was remarkably lower ($P < 0.05$). No remarkable difference was found in the time needed to expose the trigeminal nerve root into the brainstem area ($P > 0.05$)

Table 4: The intraoperative observation indexes

GROUP	N	THE PROPORTION OF CUTTING OFF THE TRUNK OR BRANCHES OF THE PETROSAL VEIN (%)	THE TIME REQUIRED TO EXPOSE THE TRIGEMINAL ROOT INTO THE BRAIN STEM (MIN)	THE NUMBER OF TIMES THE MICROSCOPE OR OPERATING TABLE WAS ADJUSTED	INCIDENCE OF CEREBELLAR CONTUSION (%)
OBSERVATION GROUP	45	0（0.00）	18.87±2.24	8.26±2.21	2（4.44）
CONTROL GROUP	45	6（13.33）	18.23±2.19	18.73±3.71	11（24.44）
T/X^2		4.464	1.370	16.264	7.283
P		＜0.05	＞0.05	＜0.05	＜0.05

3.5 The pain at different time before and after operation

No remarkable difference was found in NRS score before operation (P > 0.05). On the 3rd, 7th, 14th and 21st day after operation, the NRS scores of patients lessened remarkably, and the NRS scores of patients in the observation group were lower (P < 0.05, Fig.2).

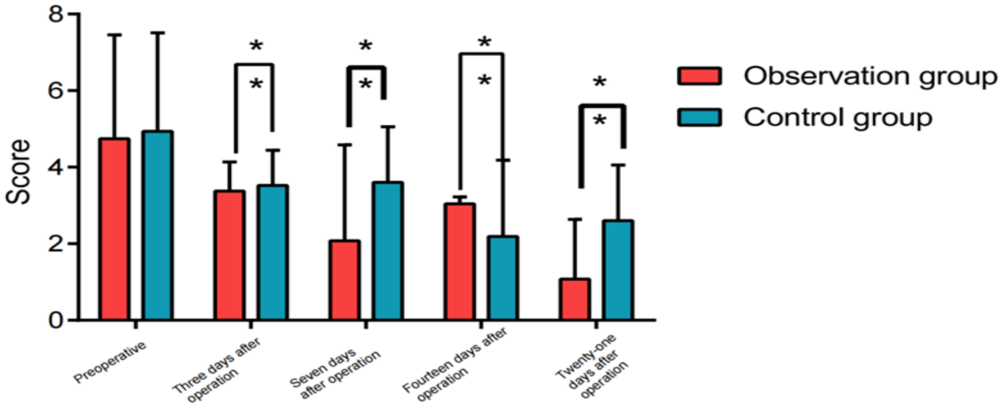

Figure 2: comparison of NRS score at different time points before and after operation.

3.6 The sleep quality at different times before and after operation

No remarkable difference was found in PSQI score before operation (P > 0.05). On the 3rd, 7th, 14th and 21st day after operation, the PSQI scores of the patients lessened remarkably. Additionally, the PSQI scores of the patients in the observation group were lower (Fig.3, P < 0.05).

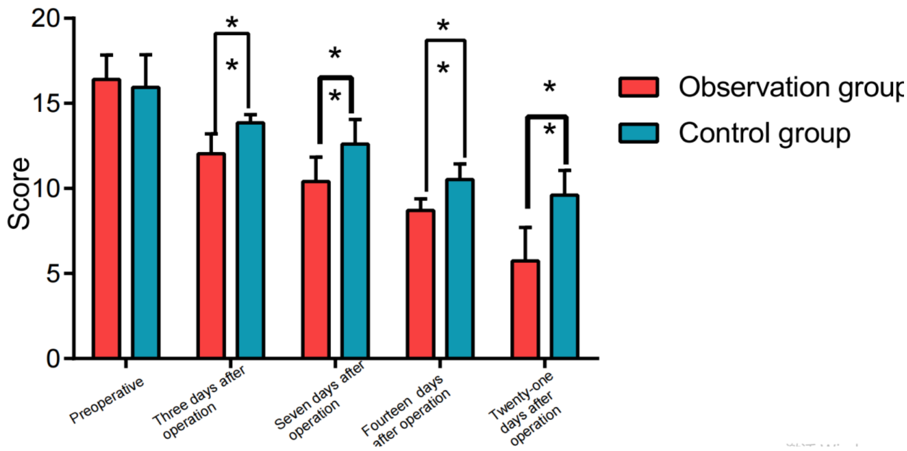

Figure 3: PSQI scores at different time points before and after operation

3.7 The pain factors before and after operation

Before operation, no remarkable difference was found in serum SP, PGE2 and β-EP levels (P > 0.05). Fourteen days after operation, the serum levels of SP, PGE2 and β-EP were remarkably lessened, and the serum levels of SP, PGE2 and β-EP in the observation group were remarkably lower (Table, P < 0.05).

Table 5: The pain factors before and after operation（n = 45, $\bar{x} \pm s$）

GROUP	SP (μg/mL)		PGE_2 (pg/mL)		β-EP (ng/L)	
	BEFORE OPERATION	AFTER OPERATION 14D	BEFORE OPERATION	AFTER OPERATION 14D	BEFORE OPERATION	AFTER OPERATION 14D
OBSERVATION GROUP	4.15±0.31	1.93±0.28[a]	168.32±9.71	90.31±6.07[a]	160.53±9.82	85.31±7.09[a]
CONTROL GROUP	4.03±0.39	2.71±0.23[b]	167.04±8.34	115.32±7.83[b]	158.32±9.18	98.37±8.04[b]
T	1.616	14.440	0.671	15.245	1.103	8.173
P	＞0.05	＜0.05	＞0.05	＜0.05	＞0.05	＜0.05

Note: *compared with the observation group before operation, a:P < 0.05, and compared with the control group, b:P < 0.05.*

3.8 The pain factors before and after operation

Before operation, no remarkable difference was found in serum IL-6, hs-CRP and TNF-α levels (P > 0.05). Fourteen days after operation, the serum levels of IL-6, hs-CRP and TNF-αwere remarkably lessened. And the serum levels of IL-6, hs-CRP and TNF-α in the observation group were remarkably lower (Table 6, P < 0.05).

Table 6: The levels of inflammatory factors before and after operation（n = 45，$\bar{x}$±s）

GROUP	IL-6 (pg/ml)		hs-CRP (mg/L)		TNF-α (ng/L)	
	BEFORE OPERATION	AFTER OPERATION 14D	BEFORE OPERATION	AFTER OPERATION 14D	BEFORE OPERATION	AFTER OPERATION 14D
OBSERVATION GROUP	7.08±0.71	4.66±0.34[a]	6.83±0.39	3.08±0.31[a]	5.71±0.42	2.72±0.38[a]
CONTROL GROUP	7.03±0.82	5.91±0.46[b]	6.74±0.55	4.26±0.58[b]	5.53±0.36	3.63±0.44[b]
T	0.309	14.659	0.895	12.036	2.813	10.500
P	＞0.05	＜0.05	＞0.05	＜0.05	＞0.05	＜0.05

Note: *compared with the observation group before operation, a:P<0.05, and compared with the control group, b:P<0.05.*

3.9 The postoperative complications

In the observation group, there were 1 people of intracranial hematoma and 1 people of facial nerve paralysis, and the incidence of postoperative complications was 4.44%. In the control group, there were 3 people of intracranial hematoma, 2 people of subcutaneous effusion, 1 people of intracranial infection, 1 people of cerebrospinal fluid leakage and 5 people of cranial nerve paralysis. The incidence of postoperative complications was 17.787% (P < 0.05). The results of the study are listed in Table 7.

Table 7: The postoperative complications (n/%)

GROUP	N	INTRACRANIAL HEMATOMA	SUBCUTANEOUS EFFUSION	INTRACRANIAL INFECTION	CEREBROSPINAL FLUID LEAKAGE	FACIAL NERVE PARALYSIS	TOTAL INCIDENCE RATE（%）
OBSERVATION GROUP	45	0(0.00)	1(2.22)	0(0.00)	0(0.00)	1(2.22)	2(4.44)
CONTROL GROUP	45	1(2.22)	2(4.44)	1(2.22)	1(2.22)	3(6.67)	8(17.78)
X^2							4.349
P							＜0.05

4. Discussion

The main pathogenesis of TN is that after the trigeminal nerve is compressed by local vascular tissue, the nerve has demyelination pathological changes, and pseudo synapses are formed between adjacent nerve axons. Because the demyelinating nerve is prone to spontaneous excitation, and then through the false synapse to the adjacent nerve axons, cross-excitation, or short circuit, and finally form a major nervous attack (Di Stefano et al., 2019). Microvascular decompression is the first choice for the treatment of primary TN. MVD has many advantages such as remarkable efficacy, low recurrence rate and minimal nerve damage (Andersen et al., 2022). The treatment involves isolating the responsible vessels from the trigeminal nerve with cotton pads, which does not destroy the integrity of the nerve structure and maintains its normal function with reliable efficacy (Lambru et al., 2022).The common surgical approach for microvascular decompression is the suboccipital retro-sigmoid trans-lateral approach, usually through mannitol dehydration before craniotomy, full release of cerebrospinal fluid during the operation and the use of posture to make the cerebellar hemisphere droop naturally. In some cases, the exposure of the trigeminal nerve is limited due to the visual angle of the traditional lateral cerebellar approach and the proximity of the trigeminal nerve, the rock vein and the facial auditory nerve, especially as the rock vein has many branches, is tortuous and has a short trunk, which will seriously compromise the exploration and manipulation of the trigeminal nerve, especially into the brainstem (Ganz, 2022; Ruscheweyh & Straube, 2019). The exposure space can be increased by stretching the cerebellar hemisphere, petrosal vein, and trigeminal nerve, to meet the requirements of full exploration of trigeminal nerve and its separation from responsible blood vessels during operation. However, excessive traction increases the risk of cerebellar contusion, petrosal vein rupture and trigeminal nerve injury. In this study, the trunk or branches of petrosal vein were cut off in 6 cases in the control group, and the bleeding was quickly stopped by gelatin sponge compression and electrocoagulation welding, and no serious complications occurred after operation. In the case of bleeding from a ruptured valve vein, gelatin sponge compression and electrocoagulation welding provide excellent haemo stasis with few associated complications. However, the occurrence of valvular vein hemorrhage can seriously affect the procedure and operator confidence, increasing the risk of injury to adjacent nerves and blood vessels during hemostasis (S. Gupta et al., 2022). Therefore, there is an urgent need to find a suitable surgical approach to reduce skull injury and reduce the incidence of postoperative complications. Study results indicated that the total effective rate for the observation group was 95.56% and the control group was 84.44%. It is suggested that microvascular decompression petrosal fissure and cerebellopontine fissure approach is more effective and effective in the treatment of TN than conventional bone flap approach. In addition, the results of this study indicated that the operation time of the observation group was remarkably shorter, and the amount of intraoperative bleeding was remarkably less. The traditional bone flap method has a star point as the reference position for the resection of the bone window, which is not very accurate and may have a large margin of error, which can prolong the operation. The surgery is also prone to damage to the transverse and sigmoid sinuses and other tissues, with a high risk of bleeding, large bone flap tissue, and a variety of complications such as subcutaneous effusion and intracranial hematoma (Munoz et al., 2022). Cerebellar horizontal fissure, also known as cerebellar petrosal fissure, is the largest horizontal fissure in the cerebellar hemisphere. From back to front, the cerebellar hemisphere is divided into two almost equal parts, and its anterolateral end relates to cerebellopontine fissure. Cerebellopontine fissure is located at the cerebellopontine angle, which is divided into upper limb and lower limb, which is V-shaped. The apex relates to the horizontal fissure of cerebellum, and the cerebellopontine ball is sandwiched between them. And the end of the upper limb is directly opposite the trigeminal nerve root into the brainstem area. The petrosal vein is an important draining vein of the posterior cranial fossa, the trunk is thick, short, and thin, and crosses the subarachnoid space in a free form. The majority of it operates in the upper lateral part of the trigeminal nerve and above the internal auditory canal before converging on the medial and middle segments of the superior palatine sinus, rarely entering the lateral segment of the superior palatine sinus. For patients with petrosal vein occlusion, the cerebellar fissure can be dissected from the lateral side of the cerebellar horizontal fissure until the junction of the cerebellopontine fissure and the cerebellopontine fissure, and continue to dissect the upper limb of the cerebellopontine fissure in the direction of the trigeminal nerve. The superior limb of the cerebellar fissure terminates in the trigeminal nerve root exposed for access to the brainstem for surgery, and the responsible vessels are easily identified. Simultaneously, the petrosal vein, which had seemed to block the operation, was pushed in the direction of the haptics with the superior cerebellum, and the auditory nerve was pushed in the direction of the foramen magnum with the amniotic bulb and the inferior cerebellar hemisphere, with its tension perpendicular to the long axis. The damage to the auditory nerve was almost negligible. Not only does this reduce the proportion of bleeding or truncated valve veins during surgery, it also reduces the incidence of post-operative cerebellar and brainstem haemorrhage or infarction and hearing loss. The results of this study indicated that there were 6 patients in the control group who needed to cut off the trunk or branches of the petrosal vein during the operation, but none in the observation group. Of these, the proportion of the control group severing the trunk or branches of the rock vein was lower than the 38.3% reported by others (Shulev et al., 2020), mainly because our institution placed great emphasis on protecting the rock vein before introducing the method of encircling the rock vein via the cerebellar fissure. The operation was performed by the same medical group and the same surgeon in the two groups. During dissection of the posterior cranial fossa, controls can expose the trigeminal roots into the brainstem region by releasing cerebrospinal fluid, compressing the cerebellum, and cutting off vascular blocking maneuvers. Based on releasing cerebrospinal fluid, the observation group needs to dissect from the horizontal fissure of the cerebellum to the end of the cerebellopontine fissure in order to expose the trigeminal nerve root into the brainstem area. Theoretically, the time should be longer than that of the control group. In practice, the probability of venous tears and cerebellar contusions was higher in the control group, especially in patients with skull base venous occlusion or cerebellar congestion and poor cerebrospinal fluid (CSF) release. It takes time to stop bleeding after electrocoagulation and compression. In addition, the number of intraoperative microscope or operative bed adjustment in the observation group was remarkably less. The purpose of adjusting the microscope or rotating the operating bed during the operation is to adjust the surgical field of vision for ease of operation. If cerebrospinal fluid release is poor and cerebellar prolapse is not evident in the control group, the surgical field of view becomes narrower and if the valvular vein is then blocked, the operation becomes more difficult; repeated adjustments to the microscope or surgical bed are then required to obtain a better exposure field of view and to reduce damage to the vessels, nerves and cerebellum during the operation. In the observation group, in the process of opening the cerebellar fissure, the petrosal vein and cerebellum had little influence on the operation. After the cerebellopontine fissure was opened, the trigeminal nerve root entering the brainstem area and responsible vessels were often well exposed. Therefore, the adjustment of microscope angle and operation bed will be reduced. The results of this study found that the incidence of cerebellar contusion in the observation group was lower. The trans-cerebellar petrous vein approach requires exposure of the trigeminal nerve root into the brainstem by compression of the cerebellum, especially when the cerebellum is fuller, cerebrospinal fluid release is less optimal, the subarachnoid space between the cerebellum and the petrous bone is smaller, and the cerebellum is more remarkably compressed and more severely contused. This not only takes a certain amount of time to deal with the contusion of the cerebellar cortex. It will also increase the probability of cerebellar hemorrhage and edema after operation. The pathogenesis of TN is associated with microvascular compression, trigeminal artery ischemia, plasma pain factors and inflammatory response. SP, PGE2 and β-EP belong to plasma pain factors. It is generally believed that the higher the content of pain factors in plasma, the stronger the pain of patients. In recent years, some scholars have found that it is directly related to TN, but its mechanism is not clear. IL-6, hs-CRP, and TNF-α are the most adopted evaluation indexes of inflammatory factors in clinic, and the decrease of their levels indicates that the inflammatory response is alleviated. In this study, 14 days after operation, the levels of serum SP, PGE2, β-EP, IL-6, hs-CRP, and TNF-α were remarkably lower compared to the control group, and the rate of postoperative complications in the observation group was lower. The results show that the petrosal fissure and cerebellopontine fissure approach is effective and safe in the complex microvascular decompression of pre-TN.

5. Conclusion

This investigation into the application of petrosal and cerebellopontine fissure approaches for microvascular decompression (MVD) in athletes with trigeminal neuralgia (TN) provides compelling evidence of their effectiveness and safety. The study demonstrates that these advanced surgical techniques not only enhance the surgical outcomes but also significantly improve the postoperative recovery process for athletes, a critical factor given their need for rapid return to training and competition. The findings indicate that the petrosal and cerebellopontine fissure approaches lead to shorter operation times, reduced intraoperative blood loss, and fewer postoperative complications compared to the conventional bone flap method. These benefits are crucial for preserving the long-term neurological health and athletic capabilities of the patients, reducing the disruption to their careers and lives. Furthermore, the superior pain management and improved sleep quality observed in the observation group underscore the importance of these surgical approaches in enhancing the overall quality of life for athletes' post-surgery. Moreover, the reduced inflammatory response measured by lower levels of serum markers such as IL-6, hs-CRP, and TNF-α in the observation group points to less systemic stress and quicker physical recovery, which are paramount for athletes who rely on their physical health for professional success. These findings suggest that employing the petrosal and cerebellopontine fissure approaches in MVD could be a game-changer in the management of TN in athletes.It is recommended that neurosurgical teams consider these approaches as the standard of care for athletes with TN, given their potential to achieve better surgical outcomes with fewer complications. Future studies should focus on longitudinal assessments to further evaluate long-term outcomes and the potential for these techniques to be adapted for broader applications in neurosurgery. This research not only enhances our understanding of effective TN treatment for athletes but also sets a precedent for the customization of surgical techniques to meet the specific needs of different patient demographics.

REFERENCE

Abd-Elsayed, A., Martens, J. M., Fiala, K. J., & Izuogu, A. (2022). Pulsed radiofrequency for the treatment of trigeminal neuralgia. *Current pain and headache reports*, *26*(12), 889-894.

Allam, A. K., Sharma, H., Larkin, M. B., & Viswanathan, A. (2023). Trigeminal neuralgia: diagnosis and treatment. *Neurologic Clinics*, *41*(1), 107-121.

Alwardian, M., Chrysikos, D., Samolis, A., Papachristou, A., Spartalis, E., Piagkou, M., & Troupis, T. (2021). Trigeminal Neuralgia and Potential Correlations with Anatomical Variations of the Trigeminal Nerve. *Acta*

Medica Academica, *50*(2).

Andersen, A. S. S., Heinskou, T. B., Rochat, P., Springborg, J. B., Noory, N., Smilkov, E. A., Bendtsen, L., & Maarbjerg, S. (2022). Microvascular decompression in trigeminal neuralgia-a prospective study of 115 patients. *The journal of headache and pain*, *23*(1), 1-15.

Araya, E. I., Claudino, R. F., Piovesan, E. J., & Chichorro, J. G. (2020). Trigeminal neuralgia: basic and clinical aspects. *Current neuropharmacology*, *18*(2), 109-119.

Bendtsen, L., Zakrzewska, J., Abbott, J. a., Braschinsky, M., Di Stefano, G., Donnet, A., Eide, P., Leal, P., Maarbjerg, S., & May, A. (2019). European Academy of Neurology guideline on trigeminal neuralgia. *European journal of neurology*, *26*(6), 831-849.

Bendtsen, L., Zakrzewska, J. M., Heinskou, T. B., Hodaie, M., Leal, P. R. L., Nurmikko, T., Obermann, M., Cruccu, G., & Maarbjerg, S. (2020). Advances in diagnosis, classification, pathophysiology, and management of trigeminal neuralgia. *The Lancet Neurology*, *19*(9), 784-796.

Chandra, P. S. (2022). Secondary Trigeminal Neuralgia-Surgery vs. Radiosurgery: Which is better? *Neurology India*, *70*(3), 843.

Cruccu, G., Di Stefano, G., & Truini, A. (2020). Trigeminal neuralgia. *New England Journal of Medicine*, *383*(8), 754-762.

Denison, H. J., Jameson, K. A., Sayer, A. A., Patel, H. P., Edwards, M. H., Arora, T., Dennison, E. M., Cooper, C., & Baird, J. (2021). Poor sleep quality and physical performance in older adults. *Sleep Health*, *7*(2), 205-211.

Di Carlo, D. T., Benedetto, N., Marani, W., Montemurro, N., & Perrini, P. (2022). Microvascular decompression for trigeminal neuralgia due to vertebrobasilar artery compression: a systematic review and meta-analysis. *Neurosurgical Review*, 1-10.

Di Stefano, G., Maarbjerg, S., & Truini, A. (2019). Trigeminal neuralgia secondary to multiple sclerosis: from the clinical picture to the treatment options. *The journal of headache and pain*, *20*, 1-10.

Edwards, J. W., & Shaw, V. (2021). Acupuncture in the management of trigeminal neuralgia. *Acupuncture in Medicine*, *39*(3), 192-199.

Ganz, J. C. (2022). Trigeminal neuralgia and other cranial pain syndromes. *Progress in brain research*, *268*(1), 347-378.

Gupta, M., Chitneni, A., Ghorayeb, J., Schnetzer, B., & Klusek, M. (2022). Cervical Spinal Cord Stimulation for Trigeminal Neuralgia: a Narrative Review. *Current pain and headache reports*, *26*(8), 639-645.

Gupta, S., Bansal, R. N., Sodhi, S. P. S., & Brar, G. K. (2022). Animal models-Mimicking the pain of trigeminal neuralgia. *Indian Journal of Pharmacology*, *54*(2), 138.

Jones, M. R., Urits, I., Ehrhardt, K. P., Cefalu, J. N., Kendrick, J. B., Park, D. J., Cornett, E. M., Kaye, A. D., & Viswanath, O. (2019). A comprehensive review of trigeminal neuralgia. *Current pain and headache reports*, *23*,

1-7.
Lambru, G., Lagrata, S., Levy, A., Cheema, S., Davagnanam, I., Rantell, K., Kitchen, N., Zrinzo, L., & Matharu, M. (2022). Trigeminal microvascular decompression for short-lasting unilateral neuralgiform headache attacks. *Brain*, *145*(8), 2882-2893.
Lambru, G., Zakrzewska, J., & Matharu, M. (2021). Trigeminal neuralgia: a practical guide. *Practical neurology*.
Maarbjerg, S., & Benoliel, R. (2021). The changing face of TN-A narrative review. *Headache*, *61*(6), 817-837.
Mason, E., Bulkeley, L., Watson, W., Sawkins, A., Craig, M., Hyde, J., Thompson, A., & Semmens, B. (2022). Decoding comparable morphologies: Pigmentation validated for identifying southern California Paralabrax larvae. *FishTaxa*, *25*, 9-25.
Mizobuchi, Y., Nagahiro, S., Kondo, A., Arita, K., Date, I., Fujii, Y., Fujimaki, T., Hanaya, R., Hasegawa, M., & Hatayama, T. (2021). Microvascular decompression for trigeminal neuralgia: a prospective, multicenter study. *Neurosurgery*, *89*(4), 557-564.
Munoz, A., Maxwell, C., Gofman, N., Liebman, K., & Veznedaroglu, E. (2022). The management of trigeminal neuralgia with triptans, a narrative review of the literature. *Headache: The Journal of Head and Face Pain*, *62*(5), 543-547.
Puleri, D. F., & Randles, A. (2022). The role of adhesive receptor patterns on cell transport in complex microvessels. *Biomechanics and Modeling in Mechanobiology*, *21*(4), 1079-1098.
Ruscheweyh, R., & Straube, A. (2019). Therapie der Trigeminus-Neuralgie [TN: treatment options for refractory cases. *MMW Fortschr Med*, *161*(10), 52-56.
Serner, A., Reboul, G., Lichau, O., Weir, A., Heijboer, W., Vuckovic, Z., & Boudreau, S. A. (2022). Digital body mapping of pain quality and distribution in athletes with longstanding groin pain. *Scientific Reports*, *12*(1), 9789.
Shulev, Y. A., Gordienko, K., Trashin, A., & Pechiborshch, D. (2020). Microvascular decompression in trigeminal neuralgia following vertebrobasilar dolichoectasia. *Zhurnal Voprosy Neirokhirurgii Imeni NN Burdenko*, *84*(5), 50-63.
Singh, D., Dutta, G., Jagetia, A., Singh, H., Srivastava, A. K., Tandon, M., & Ganjoo, P. (2021). Microvascular decompression for trigeminal neuralgia: experience of a tertiary care center in India and a brief review of literature. *Neurology India*, *69*(7), 206.