



Etiology, Clinical Symptoms, and Risk Factors of Oculomotor Nerve Paralysis

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Abstract

The third cranial nerve, also known as the oculomotor nerve, consists of two main components: the external parasympathetic fibers that innervate the ciliary muscles and the sphincter pupillae, and the deep somatic fibers that control the levator palpebrae superioris and four extraocular muscles. Oculomotor nerve palsy has multiple etiologies and can indicate severe underlying pathology. Damage to this nerve results in characteristic symptoms such as ptosis, diplopia, restricted eye movement, and diminished or absent pupillary light reflex. This study aims to evaluate the clinical characteristics of oculomotor nerve paralysis based on its etiology, age distribution, gender prevalence, and associated risk factors. This study employs a literature review using a narrative review design. Data were collected from various indexed and accredited electronic sources such as Scopus, SINTA, DOAJ, SpringerLink, Cochrane, Biomed, Portal Garuda, Google Scholar, Elsevier/Clinical Key, Gale, PubMed, and other relevant databases. A total of 13 relevant articles were identified for this narrative review. The findings indicate that vascular abnormalities, including microvascular ischemia, aneurysms, and subarachnoid hemorrhages, are the most frequent causes of oculomotor nerve paralysis. The most commonly reported symptoms among affected patients are ptosis and diplopia. The condition is most prevalent in individuals aged 51-60 years, and women are more susceptible to oculomotor nerve paralysis than men. The most frequent cause of oculomotor nerve paralysis is an aneurysm of the posterior communicating artery. This condition predominantly affects individuals aged 51-60 years and is more common in women.

Introduction

The oculomotor nerve exits the brainstem at the base of the midbrain caudal to the mammillary bodies. The oculomotor nerve passes through the cavernous sinus and continues through the supraorbital fissure to reach the orbit of the eye. The third cranial nerve has both somatic and autonomic fibers. Somatic nerve fibers are bundled in the nerve, while autonomic (unconscious) fibers surround the somatic fibers around the outside of the nerve (Halvorson, 2018; Vaphiades & Roberson, 2017).

The oculomotor nerve runs through the lateral wall of the cavernous sinus. Cavernous sinus lesions often result in third nerve palsy accompanied by one or more other neurological findings including fourth, fifth (first division), and sixth cranial nerve palsy (Kanazawa et al.,

2020; Natarajan et al., 2022). Cranial nerve III palsy can result from a variety of causes, such as microvascular ischemia caused by diseases, including DM, hypertension, and atherosclerosis, aneurysms, trauma, neoplasms, inflammation, neurosurgical interventions, and other known rare causes (Nagendran et al., 2019; Wang et al., 2023).

Singh's report shows that the causes of oculomotorius paralysis are congenital or acquired, congenital 43%, trauma 20%, inflammation 13%, intracranial aneurysm 7% in pediatric patients, while vascular disease, intracranial aneurysm, and trauma are the most common causes among adult patients. At the same time, diabetes mellitus, painful ophthalmoplegia, and cerebral infarction are also etiologies of the disease. A 10-year cohort study of Koreans showed that the incidence of oculomotorius increased annually from 2006 to 2015 and was more common in older adults, with a significantly increased incidence after the age of 60, greatly affecting the quality of life of patients. Therefore, the number of studies on oculomotorius palsy has increased dramatically in recent decades. However, studies on publication patterns, literature characteristics are still scarce (Joyce et al., 2023; Tian & Fu, 2020).

Some of the most common etiologies that cause oculomotor nerve palsy are reported. In 1 population-based study, the incidence of oculomotor nerve palsy was found to be 4.2 per 100,000 Publishers: Faculty of Medicine - Universitas Muslim Indonesia 13 Fakumi Medical Journal: Journal of Medical Students Vol. 04 No.01 (January, 2024) E-ISSN: 2808-9146 patients.1 Of 145 cases of oculomotory nerve palsy in 1 US region over 37 years, the most common cause was microvascular (42%), followed by trauma (), compression by neoplasm (11%), iatrogenic (neurosurgical operations) at 10% and compression by aneurysm at 6%. Most aneurysm cases are caused by intracavernous aneurysms which have a low rupture rate and are located extradurally with low mortality and morbidity. Only 17% of patients with microvascular lesions involved the pupil, whereas in 64% of patients with compressive lesions the pupil was involved. Lesions in the subarachnoid space can cause complete or partial paralysis or without pupillary involvement (Forrester et al., 2015; Yi, 2020).

Methods

This study used a qualitative approach with a literature study method (Moleong, 2021) to examine the etiology, clinical symptoms, and risk factors in oculomotorius nerve palsy. The literature study was conducted by searching, collecting, and analyzing various relevant scientific sources, such as international and national journals, medical textbooks, and previous research reports. These sources were obtained through electronic databases such as PubMed, ScienceDirect, and Google Scholar, using keywords appropriate to the research topic. Inclusion criteria in this study included publications that addressed the etiology, clinical symptoms, and risk factors of oculomotory nerve palsy within the last 15 years, while exclusion criteria included articles that were not available in full text or were not relevant to the focus of the study.

Data analysis was conducted through the content analysis method with a descriptive approach (Kusumastuti & Khoiron, 2019). Each article or literature obtained was evaluated based on its validity and relevance to the research topic, then the collected data were categorized according to the three main aspects studied, namely etiology, clinical symptoms, and risk factors. The results of the analysis from various sources were explained systematically to gain a more comprehensive understanding of oculomotor nerve palsy. Thus, this study is expected to provide a clear picture of the causes, clinical manifestations, and factors that contribute to the condition.

In addition, to increase the validity and credibility of the research results, source triangulation was conducted by comparing findings from various high-confidence literature. The literature used came from journals with good impact factors (Creswell, 2019), recognized medical reference books, as well as clinical guidelines from relevant health organizations. With this

approach, the research is expected to produce accurate and in-depth information regarding oculomotor nerve palsy, so that can be a reference for medical practitioners, academics, and other parties interested in the fields of neurology and ophthalmology.

Result and Discussion

Table 1. Literature Review Results

Name	Title	Methods	Author, Year of Publication	Results
Journal of Ophthalmology & Clinical Research	The Incidence and Etiology of 3rd, 4th, 6th, and Multiple Cranial Nerve Palsies in South India: A 6-Month Retrospective Prevalence Study	<i>Descriptive with secondary data</i>	(Habeel et al., 2022)	A total of 391 outpatients were seen with CN3, CN4 and CN6 paralysis. Of these 391 patients, 88 had CN3 paralysis, 58 had CN4 paralysis, 213 had CN6 paralysis, and 32 had multiple cranial nerve paralysis. The most common etiology regardless of the affected cranial nerve was microvascular ischemia in 227 patients (58%). The second most common etiology was trauma in 48 patients (12.3%), from the results of 88 patients with oculomotorius nerve palsy, the etiology was found to be 38 patients with ischemic microvascular, 17 patients with trauma, 8 patients with inflammation, 1 patient with idiopathic, 3 patients with neoplasm, 8 patients with CVA (cerebrovascular accident). The most common symptom was diplopia, present in 391 patients, followed by ptosis in 67 patients (17.1%), pain in 29 patients (7.4%), and blurred vision in 25 patients (6.4%).
Journal of health science and medical research	Isolated Third Cranial Nerve Palsy: Aetiology - Clinical Profile and Recovery at a Tertiary Neuro- ophthalmology Center on the East Coast Peninsular of Malaysia	<i>Retrospective cohort</i>	(Nurul-Ain et al., 2022)	The 33 patients consisted of 15 males and 18 females and their ages ranged from 14 to 79 years old. Eighteen patients (54.5%) had medical risk factors; specifically diabetes mellitus, hypertension and dyslipidemia, either alone or combined, while 15 patients (45.5%) were previously healthy, with no comorbidities. Most of our ITCNP cases (39.4%, 13 patients) were associated with microvascular ischemia, while 30.3% (ten patients) developed ITCNP after trauma; all from traffic accidents. Aneurysms were observed in five patients (15.2%). These consisted of two with posterior communicating artery aneurysms (PCOM), two with internal carotid artery (ICA) aneurysms and one patient with a basilar artery aneurysm. Addition, 9.1% (three patients) had known tumors, consisting of two meningiomas and one pituitary macroadenoma. The remaining two patients (6.1%) had an undetermined cause of ITCNP. Twenty-four patients (72.8%) presented with ptosis, while 13 patients (39.4%) presented with diplopia. Periorbital pain was present in 22 patients (66.7%), with five patients (15.2%) having severe headaches. Twenty patients (60.6%) showed pupillary involvement and anisocoria.
South african journal of radiology	Recovery of oculomotor nerve palsy after endovascular management of posterior communicating artery aneurysms	<i>Cohort with retrospective method</i>	(Abdurahman et al., 2020)	Of the 34 patients with oculomotor nerve palsy, comorbidities (hypertension/diabetes mellitus) were found in 16 patients (47%), while 18 patients (53%) had no comorbidities. ONP was complete in 32 patients (94.1%) and partial in 2 patients (6.9%) Subarachnoid hemorrhage (SAH), corresponding to aneurysm rupture, was present in 27 patients (79.4%) with ONP, while 7 patients (20.6%) had unruptured aneurysms.
La Tunisie Medicale	Clinical patterns of third nerve palsies in diabetic patients	<i>Retrospective cohort</i>	(Saad et al., 2020)	Six men and five women were included (41 - 81 years); the mean duration of diabetes was (0 - 30 years). Initial clinical symptoms included inability to

				open the eyes in all patients. Eight out of 11 patients complained of diplopia. Six patients had headaches, and periocular pain was noted in three cases. Third nerve palsy was complete in all patients.
Dove Press Eye And	Clinical Prediction Score for Early Neuroimaging in Acquired Isolated Oculomotor Nerve Palsy	Retrospective cohort	(Witthayaweerasak et al., 2020)	Ninety-five patients (98.9%) were unilateral. Forty-one eyes (42.3%) were caused by ischemia while the other 56 (57.7%) were caused by non-ischemic etiologies including aneurysm (n= 22), head trauma (n= 18), inflammation (n= 5), tumor (n= 4), postoperative intracranial surgery (n= 3), subdural hematoma causing uncal herniation (n= 1), midbrain stroke (n=1), and undetermined causes (n= 2).
Somatosensory & Motor Research	The aetiology of unilateral oculomotor nerve palsy : a clinical analysis on 121 patients	Cohort retrospective	(Chen et al., 2019)	Clinical features of 121 patients with unilateral oculomotor nerve palsy included ptosis (60.1%), diplopia (47.0%), headache (37.8%), blurred vision (35.2%), periorbital pain 24.1%), and dizziness (6.0%). The outcome study of this study showed that the etiologies in 121 patients with oculo-motor nerve palsy included aneurysm (29.8%), diabetes (26.5%), painful ophthalmoplegia (9.9%), pituitary chamber lesion (5.0%), trauma (5.8%), cavernous sinus disease (5.0%), brainstem encephalitis (0.8%), brainstem infarction 2.5%), and unknown cause (14.9%).
Scientific Journal of Medicine Wijaya	Incidence and Etiology of Third, Fourth and Sixth Nerve Palsy Accompanied by Binocular Diplopia at RSUD DR. Wahidin Sudiro Husodo	Descriptive with secondary data	(Dhany et al., 2019)	The results showed that the most common cause of paresis nervus III, IV, VI as much as 58.3% was microvascular. Of the 7 patients with microvascular etiology, diabetes mellitus as the most risk factor as many as 6 people and 1 person with hypertension. Other causes are intracranial neoplasm of 16.7%, trauma aneurysm and post-operative neurosurgery meningioma have the same percentage of 8.3%. The results showed that the most common causes of binocular diplopia were paresis nervus VI as much as 33.3%, paresis nervus III partial 25%, paresis nervus III total 16.7%, paresis nervus III pupil sparing 8.3% and paresis nervus III, IV, VI combined 16.7%.
Turkish Journal of Neurology (Year 2019)	Isolated Third, Fourth, and Sixth Cranial Nerve Palsies in the Turkish Population: Etiologic Factors and Clinical Course	Descriptive with secondary data	(İlksen Çolpak & Batur Çağlayan, 2019)	A total of 127 (78 male, 49 female) patients were analyzed. Forty-five patients (35.4%) had third nerve palsy, 34 (26.8%) fourth nerve palsy, and 48 patients (37.8%) sixth nerve palsy. Diplopia was the main symptom seen in all patients. In 15 patients with accompanying periorbital pain, the diagnosis was third (n=7) and sixth nerve palsy (n=8). Nine patients had ptosis and all had third nerve palsy. 21 patients had anisocoria; one of these patients had fourth nerve palsy due to carotico-cavernous fistula (CCF), and the rest had third nerve palsy. The most common etiology for all groups was vasculopathy, which was seen in 21 patients (35.6%) with third nerve palsy, 15 (25.4%) with fourth nerve palsy, and 23 (39%) patients with sixth nerve palsy.
Asian Journal of	Recovery of oculomotor nerve palsy after endovascular and surgical treatment of posterior communicating artery aneurysms: A single institutional experience	Retrospective cohort	(Mak et al., 2018)	Overall, 13 (59%) patients had unruptured aneurysms while 9 (41%) patients had Grade 1 or 2 subarachnoid hemorrhage (SAH) Partial oculomotor nerve palsy was found in 9 (41%) patients while 13 (59%) had complete oculomotor nerve palsy.
International Journal of Contemporary Medical Research	Clinical Study of 3rd, 4th and 6th Cranialnerve Palsies Leading to Visual Disturbances	Prospective Cohort	(Kumar et al., 2018)	A total of 50 patients were included, Most patients had diplopia in 29 (58%) cases, followed by ptosis in 9 (18%) cases; headache and eye pain in 7 (14%) cases and 4 (8%) cases respectively. 6th nerve palsy (36%) was the most common followed by 3rd nerve palsy (30%).

Jama	Incidence and Etiologies of Acquired Third Nerve Palsy Using a Population-Based Method	<i>Descriptive with secondary data</i>	(Fang et al., 2017)	From the results 145 new cases of acquired third nerve palsy were diagnosed in the specified population. The number of cases per year ranged from 1 to 12. There were 58 males (40%) and 87 females (60%). The most common causes were thought to be microvascular (42%), trauma (12%), compression from neoplasm (11%), post neurosurgery (10%), compression from aneurysm (6%), other causes (5%), stroke (4%), undetermined (4%), pituitary apoplexy (2%), Tolosa-Hunt syndrome 2%), and giant cell arteritis (1%). One hundred and twenty-five of 145 patients (86%) with acquired third nerve palsy had ptosis at presentation. A total of 81 out of 145 cases (56%) were neurologically isolated (excluding headache or eye pain).
Edorium J Neuro	A study of the etiology and prognosis of oculomotor nerve paralysis	<i>Retrospective cohort</i>	(Kumar et al., 2014)	In 37 (92.5%) patients, oculomotor nerve palsy was unilateral while in 3 (7.5%) patients it was bilateral. In this series, 23 (57.5%) cases in third cranial nerve palsy, the causes were microvascular ischemia (20%), post-traumatic (17.5%), undetermined etiology (20%), neurotuberculosis (12.5%) and intracranial aneurysm. (7,5%).
Indian Journal of Ophthalmology	Incidence of pupillary involvement, course of anisocoria and ophthalmoplegia in diabetic oculomotor nerve palsy	<i>Cohort retrospective</i>	(Bhandari & Yadalla, 2013)	Of the 35 patients studied among other risk factors associated with the development of vasculopathic oculomotor nerve palsy, hypertension was most commonly seen (42.8%), followed by hypercholesterolemia (40%), smoking (28.57%), coronary artery disease 14.2%) and alcoholism (11.3%). And the results showed 9 patients (25.7%) were found to have internal ophthalmoplegia along with external ophthalmoplegia and the average duration of diabetes was 5.7 years. Some degree of anisocoria (pathological and simple anisocoria) was measured in 31.1% of patients at presentation.

Based on a literature review, the common causes of oculomotory nerve paralysis are classified into several causes, namely, vascular, neurologic, trauma, and autoimmune. The paralysis of the oculomotory nerve causes symptoms such as diplopia, ophthalmoplegia, ptosis, and anisocorrhea

From the journal findings above, the eligibility criteria were met by 13 studies published from 2013 to 2023. Observational research methods with a retrospective cohort approach 61.53% (8 of 13), Descriptive with secondary data 30.76% (4 of 13), observational with a retrospective cohort approach 7.69% (1 of 13). Research by Hao Chen et al (2019), stated that the etiology of 121 patients with paralysis of the oculomotorius nerve included aneurysm (29.8%) diabetes (26.5%), opthalmoplegia (9.9%) lesions of the pituitary (5.0%) disease of the cavernous sinus (5.0%) brainstem encephalitis (0.8%), brainstem infarction (2.5%) and unknown causes (14.9%).⁷ This study is in accordance with Juthamat Witthayaweerasak (2020), that of the 95 patients studied, the cause of paralysis of the oculomotorius nerve caused by non-ischemic was 56 eyes, namely aneurysms as many as 22 and followed by trauma, and tumors and 41 eyes caused by ischemic (Chen et al., 2019; , 2019; Witthayaweerasak et al., 2020) Witthayaweerasak, 2020).

Fang et al., (2017) stated that from the results of 145 cases the most common cause was microvascular and followed by 44 trauma, and neoplasm.²³ Similar to Nurul-Ain et al., (2022) the results of 33 patients, 13 patients with oculomotorius nerve palsy were associated with microvascular ischemic then followed by trauma, aneurysm, and tumor. Similar to Maraiah Pradeep (2014) said the most common cause was microvascular ischemic followed by trauma and aneurysm (Fang et al., 2017; Nurul-Ain et al., 2022).

Research by Hao Chen et al (2019), stated that of 121 patients with unilateral oculomotorius nerve paralysis had a clinical picture including ptosis (60.1%), diplopia (47%). Headache (37.8%), blurred vision (35.2%), periorbital pain (24.1%) and dizziness (6.0%). Similar to research conducted by Cheng bo fang et al (2017) of 145 patients there were 125 patients with paralysis of the oculomotorius nerve experiencing ptosis. Masnon nurul Ain et al (2022) also mentioned in their research from 33 as many as 24 patients with ptosis, 13 patients with diplopia. The same thing was mentioned in a study conducted by Samer (2022) the symptoms that most often appear in patients are ptosis followed by pain and blurred vision (Chen et al., 2019; Nurul-Ain et al., 2022).

Whereas in the research of Ayşe İlksen Çolpak et al (2019) stated that diplopia was the main symptom in all patients with paralysis of the oculomotorius nerve 9 patients had ptosis and 20 patients had anisocoria (İlksen Çolpak & Batur Çağlayan, 2019).

Based on age in patients with oculomotorius nerve paralysis according to research by Masnon Nurul-Ain, et al (2022) of 33 patients the age of the patients ranged from 14-79 years. Where 18 of them were women and 14 of them were men (Nurul-Ain et al., 2022).

From the above research, the most common cause is aneurysm where aneurysms can cause paralysis of the oculomotor nerve, the aneurysm that most often causes paralysis of the oculomotor nerve is the posterior communicating artery where the aneurysm in the artery compresses the oculomotor nerve in the subarachnoid space, which will give symptoms in the form of ptosis, diplopia, and ophthalmoplegia. Aneurysms often occur in patients with a history of diabetes and hypertension. Where in the above study the most common etiology was caused by diabetes and hypertension which would cause paralysis of the oculomotorius nerve.

The journals discussed here make unique contributions to understanding oculomotor nerve palsy, although each journal has its own strengths and weaknesses. Some journals stand out for their broad-based population approach, while others focus more on specific clinical experiences or a particular etiology.

The Journal of Ophthalmology & Clinical Research (2022) provides a retrospective overview of the prevalence and etiology of cranial nerve palsy in South India. With data covering the distribution of etiologies such as microvascular and trauma, the journal excels in providing specific geographical context. However, the limited study time of six months is a major drawback.

Journal of Health Science and Medical Research (2022) stands out with its in-depth analysis of clinical profiles and patient recovery. Its focus on clinical data at a single center provides detailed insights but underrepresents the global population. This study complements retrospective analysis from other journals such as the Turkish Journal of Neurology (2019), which is broader but less in-depth in aspects of patient recovery.

Somatosensory & Motor Research (2019) offers rich clinical data on the symptoms of oculomotor nerve palsy. By identifying major etiologies such as aneurysms and diabetes, the journal has a broad scope. However, this study is limited to a specific population and lacks cross-regional comparisons, like Jama Ophthalmology (2017), which is population-based. Jama Ophthalmology (2017) has the advantage of population-based coverage, including age and gender distribution of patients. However, the lack of analysis on treatment or follow-up makes it less complete than Asian Journal of Neurosurgery (2018), which focuses on recovery through specific treatment methods.

Turkish Journal of Neurology (2019) and Scientific Journal of Medicine Wijaya Kusuma (2019) both highlighted local data. The Turkish Journal provides a broad etiologic analysis on the population, while the Scientific Journal of Medicine Wijaya Kusuma provides specific data for Indonesia. Both lack detailed discussion of patient prognosis, an aspect raised by Edorium

J Neuro (2014). Edorium J Neuro (2014) itself provides a good analysis of prognosis, but the small study data is a major weakness. This journal offers insight into causes such as neurotuberculosis, which are rarely discussed in other journals.

The Asian Journal of Neurosurgery (2018) excels in exploring the relationship between treatment methods (endovascular and surgical) and oculomotor nerve recovery. This focus makes it more relevant for clinical studies addressing treatment strategies than other journals such as the International Journal of Contemporary Medical Research (2018), which is more general in scope. And the Indian Journal of Ophthalmology (2013) stands out with a focus on diabetic patients, providing a unique contribution on pupillary involvement and disease course. However, its coverage is limited to the diabetic population, unlike the broader Jama Ophthalmology (2017).

Taken together, each of these journals makes an important contribution to understanding the various aspects of oculomotor nerve palsy. The combination of population-based studies and local clinical studies provides a more comprehensive picture of this condition. Future prospective and multinational studies can enrich these findings by comparing broader populations and provide deeper insights into prognosis and treatment.

Conclusion

From the results of this study, it shows that paralysis of the nervus oculomotorius is most often caused by aneurysms such as microvascular ischemia, aneurysms, bleeding in the subarachnoid space and trauma. The symptoms that most often arise in several studies that have been mentioned are ptosis and diplopia, and the age that is prone to paralysis of the nervus oculomotorius at the age of 51-60 years. From the research above, it is also concluded that women are more likely to have paralysis of the oculomotory nerve.

References

- Abdurahman, E., Amod, K., Royston, D., & Harrichandparsad, R. (2020). Recovery of Oculomotor Nerve Palsy after Endovascular Management of Posterior Communicating Artery Aneurysms. *South African Journal of Radiology*, 24(1). <https://doi.org/10.4102/sajr.v24i1.1887>
- Bhandari, S., & Yadalla, D. (2013). Incidence of Pupillary Involvement, Course of Anisocoria and Ophthalmoplegia in Diabetic Oculomotor Nerve Palsy. *Indian Journal of Ophthalmology*, 61(9), 533–534. <https://doi.org/10.4103/0301-4738.119462>
- Chen, H., Wang, X., Yao, S., Raza, H. K., Jing, J., Cui, G., & Hua, F. (2019). The Aetiologies of Unilateral Oculomotor Nerve Palsy: A Clinical Analysis on 121 Patients. *Somatosensory & Motor Research*, 36(2), 102–108. <https://doi.org/10.1080/08990220.2019.1609438>
- Creswell, J. W. (2019). *Research design pendekatan kualitatif, kuantitatif, dan mixed* (A. Fawaid & S. Z. Qudsy, Eds.; 5th ed., Vol. 3). Yayasan Mitra Netra.
- Dhany, R. K., Tanjung, Y., & Jennel, F. (2019). Insiden dan Etiologi Kelumpuhan Saraf III, IV dan VI yang Disertai Diplopia Binokuler di RSUD DR. Wahidin Sudirohusodo. *Jurnal Ilmiah Kedokteran Wijaya Kusuma*, 8(2), 1–6. <https://doi.org/10.30742/jikw.v8i2.480>
- Fang, C., Leavitt, J. A., Hodge, D. O., Holmes, J. M., Mohny, B. G., & Chen, J. J. (2017). Incidence and Etiologies of Acquired Third Nerve Palsy Using a Population-Based Method. *JAMA Ophthalmology*, 135(1), 23. <https://doi.org/10.1001/jamaophthalmol.2016.4456>
- Forrester, J. V., Dick, A. D., McMenamin, P. G., Roberts, F., & Pearlman, E. (2015). *The eye:*

- Habeel, S., Kumar, K., MacIntosh, P. W., & Shah, V. M. (2022). The Incidence and Etiology of 3rd, 4th, 6th, and Multiple Cranial Nerve Palsies in South India: A 6-Month Retrospective Prevalence Study. *Journal of Ophthalmology & Clinical Research*, 6(2), 133–138. <https://dx.doi.org/10.33140/JOCR>
- Halvorson, K. L. (2018). *Cranial Nerve III Palsy. Clinical Cases in Eye Care*. Wolters Kluwer Health.
- İlksen Çolpak, A., & Batur Çağlayan, H. (2019). Isolated Third, Fourth, and Sixth Cranial Nerve Palsies in the Turkish Population: Etiologic Factors and Clinical Course. *Turkish Journal Of Neurology*, 25(1), 32–35. <https://doi.org/10.4274/tnd.galenos.2019.29795>
- Joyce, C., Le, P. H., & Peterson, D. C. (2023). *Neuroanatomy, Cranial Nerve 3 (Oculomotor)*. StatPearls Publishing.
- Kanazawa, T., Hino, U., Kuramae, T., & Ishihara, M. (2020). Idiopathic Unilateral Oculomotor Nerve Palsy: A Case Report. *Heliyon*, 6(12), e05651. <https://doi.org/10.1016/j.heliyon.2020.e05651>
- Kumar, K. H., Bhanu, K. B. C., & Ashok, R. (2018). Clinical Study of 3rd, 4th and 6th Cranialnerve Palsies Leading to Visual Disturbances. *International Journal of Contemporary Medical Research [IJCMR]*, 5(4). <https://doi.org/10.21276/ijcmr.2018.5.4.48>
- Kumar, M. P., Vivekanand, U., & Umakanth, S. (2014). A Study of Etiology And Prognosis of Oculomotor Nerve Paralysis. *Edorium J Neurol*, 1, 1–8. <http://dx.doi.org/10.5348/n06-2014-1-OA-1>
- Kusumastuti, A., & Khoiron, A. M. (2019). *Metodologi Penelitian Kualitatif* (F. Annisya & Sukarno, Eds.). Lembaga Pendidikan Sukarno Pressindo.
- Mak, S., Qiu, L., & Ng, Y. (2018). Recovery of Oculomotor Nerve Palsy after Endovascular and Surgical Treatment of Posterior Communicating Artery Aneurysms: A Single Institutional Experience. *Asian Journal of Neurosurgery*, 13(03), 555–559. <https://doi.org/10.4103/1793-5482.238085>
- Moleong, L. J. (2021). *Metodologi Penelitian Kualitatif* (40th ed., Vol. 14). Remaja Rosdakarya.
- Nagendran, S. T., Lee, V., & Perry, M. (2019). Traumatic Orbital Third Nerve Palsy. *British Journal of Oral and Maxillofacial Surgery*, 57(6), 578–581. <https://doi.org/10.1016/j.bjoms.2019.01.029>
- Natarajan, D., Kannam, M., Reddy, M. V. V., & Sachdeva, V. (2022). Systemic Lupus Erythematosus and Third Nerve Palsy: Unusual Presentation and Review of the Literature. *Neuro-Ophthalmology*, 46(2), 109–114. <https://doi.org/10.1080/01658107.2021.1912113>
- Nurul-Ain, M., Wan Hitam, W. H., Shatriah, I., & Abdul Halim, S. (2022). Isolated Third Cranial Nerve Palsy: Aetiology - Clinical Profile and Recovery at a Tertiary Neuro-ophthalmology Centre on the East Coast Peninsular of Malaysia. *Journal of Health Science and Medical Research*, 41(2), 1–13. <https://doi.org/10.31584/jhsmr.2022901>
- Saad, G., Ben Abdelkrim, A., Beizig Maaroufi, A., Njah Kacem, M., Chaieb Chadli, M., & Ach, K. (2020). Clinical Patterns of Third Nerve Palsies in Diabetic Patients. *La Tunisie Medicale*, 98(6), 513–517.

- Tian, L., & Fu, Q. (2020). Recovery of Posterior Communicating Artery Aneurysm Induced Oculomotor Nerve Palsy: A Comparison between Surgical Clipping and Endovascular Embolization. *BMC Neurology*, 20(1), 351. <https://doi.org/10.1186/s12883-020-01847-5>
- Vaphiades, M. S., & Roberson, G. H. (2017). Imaging of Oculomotor (Third) Cranial Nerve Palsy. *Neurologic Clinics*, 35(1), 101–113. <https://doi.org/10.1016/j.ncl.2016.08.009>
- Wang, R., Gao, Y., Wu, S., Cai, X., Yu, T., & Wang, L. (2023). Research Hotspots and Trends of Oculomotor Nerve Palsy from 2001 to 2021 Based on Web of Science: A Bibliometric Analysis. *Frontiers in Neurology*, 14. <https://doi.org/10.3389/fneur.2023.1112070>
- Witthayaweerasak, J., Tansuebchueasai, N., & Aui-aree, N. (2020). Clinical Prediction Score for Early Neuroimaging in Acquired Isolated Oculomotor Nerve Palsy. *Eye and Brain, Volume 12*, 89–95. <https://doi.org/10.2147/EB.S253305>
- Yi, T. M. (2020). *Cranial Nerves. Anatomy, Function and Clinical Significance* (1st ed.). Nova Sscience Publishers.