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Original Article

The Anatomical Landmarks in Endonasal Endoscopic Optic Nerve Decompression Surgery: An Anatomical Study

Endonazal Endoskopik Optik Sinir Dekompresyon Cerrahisindeki Anatomik Belirteçler: Anatomi Çalışması

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Abstract

Aim: Optic nerve decompression can be applied for many pathologies that affect the optic canal and the optic nerve. Optic nerve decompression via endonasal endoscopic method is very popular in nowadays with the developments in endoscopic surgery.

Material and Methods: In this study, the lateral opticocarotid recess (LOCR) and the medial opticocarotid recess (MOCR) which are important anatomical landmarks used during transsphenoidal approach to the opticocarotid region were evaluated. The relations of these anatomical landmarks with each other and with important surrounding landmarks such as optic nerve were examined.

Results: MOCR were observed in all cadavers on the right side and in 4 of 5 cadavers on the left side. The superior border of the LOCR was measured as 4.85±1.94 mm in average on the right side and 3.93±1.11 mm in average on the left side. The inferior border of the LOCR was measured as 4.72±2.11 mm in average on the right side and 3.98±1.67 mm in average on the left side. The linear distance between the LOCR and the MOCR was measured as 3.11±1.41 mm in average on the right side and 2.46±1.36 mm in average on the left side.

Conclusion: It is necessary for a safe surgery to reveal the anatomical landmarks and to know the detailed anatomy of this region during optic nerve decompression.

Keywords: Optic nerve; optic canal; decompression; landmarks; endoscopic

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Öz

Amaç: Canalis opticus'u ve nervus opticus'u etkileyen pek çok patoloji için nervus opticus dekompresyonu yapılmaktadır. Endonazal endoskopik yol ile yapılan nervus opticus dekompresyonu, endoskopik cerrahideki gelişmeler ile de günümüzde oldukça revaçtadır.

Gereç ve Yöntemler: Bu çalışmada opticocarotid bölgeye transsfenoidal yaklaşım sırasında kullanılan ve önemli anatomik belirteçler olan materal optikorarotid recess (LOCR) ve medial opticocarotid recess (MOCR) incelendi. Bu anatomik belirteçlerin birbiri ile olan ve nervus opticus gibi önemli çevre anatomik yapılar ile olan ilişkileri değerlendirildi.

Bulgular: MOCR sağ tarafta tüm kadavralarda ve sol tarafta 5 kadavranın 4 tanesinde belirgin olarak izlendi. LOCR superior kenarı sağ tarafta ortalama 4,85±1,94 mm ve sol tarafta ortalama 3,93±1,11 mm aralığında ölçüldü. LOCR inferior kenarı sağ tarafta ortalama 4,72±2,11 mm ve sol tarafta ortalama 3,98±1,67 mm aralığında ölçüldü. LOCR ile MOCR arasındaki lineer mesafe sağ tarafta ortalama 3,11±1,41 mm ve sol tarafta ortalama 2,46±1,36 mm aralığında ölçüldü.

Sonuçlar: Nervus opticus dekompresyonu sırasında anatomik belirteçlerin ortaya konulabilmesi ve bölgenin detaylı anatomisinin bilinmesi güvenli bir cerrahi için gereklidir.

Anahtar Kelimeler: optik sinir; optik kanal; dekompresyon; belirteç; endoskopik

Introduction

Optic nerve decompression is performed for pathologies that affect the optic canal and the optic nerve such as tumors, trauma, infections, vascular pathologies and sinus lesions [1].

Optic nerve decompression was firstly perfomed by Dandy in 1922 [2]. Optic nerve decompression via transethmoidal approach was firstly perfomed by Sewall [3]. Optic nerve decompression via endonasal endoscopic approach, which is a good option for pathologies that affect the optic canal especially inferiorly and medially, is also very popular in nowadays with the developments in endoscopic surgery [1, 4].

Optic nerve decompression via endonasal endoscopic approach has some advantages that it provides a panoromic view to the sellar region, does not require brain retraction, does not leave behind any incision scar and has a relatively short surgical time [1, 5, 6]. However, this surgical technique has also some possible and serious complications such as neurovascular injury (the optic nerve or the ophthalmic artery injury) [7]. For this reason, it is extremely necessary to know the detailed anatomy of this region and to be aware of the anatomical landmarks that play a key role for a safe surgery.

In this study, the lateral opticocarotid recess (LOCR) and the medial opticocarotid recess (MOCR), which are important anatomical landmarks used during the transsphenoidal approach to the opticocarotid region, were examined. The relationships of these anatomical landmarks with each other and with other important surrounding anatomical structures such as the optic nerve were also evaluated.

Material And Methods

This study was performed on a total of five (n=5) adult head cadavers in Ankara University School of Medicine, Department of Anatomy (Surgical Neuroanatomy Laboratory). Five fresh frozen cadaver heads stored at (-21)-(-5) ^{0}C and with colored silicone intravascular were used. Cadaver heads were fixed in the neutral position and examined by using the binostral approach with the Storz 0-degree rigid endoscope. (Karl Stroz SE&Co. Tuttlingen, Germany).

Transsphenoidal endoscopic approach were performed to all of the five cadaver heads. The mucosa of the sphenoid sinus was removed and the bony structure was revealed. LOCR and MOCR, the two important anatomical landmarks that located in the sphenoid sinuses of the cadavers were revealed and examined with an endoscope (Figure 1).

Measurements were made of the superior and inferior borders of the LOCR, which has a triangular shape. The relationships between the LOCR, internal carotid artery and optic nerve were revealed in all cadavers (Figure 2). The linear distance between MOCR and LOCR was measured. Each step of the anatomical dissection was recorded with digital cameras.

Results

LOCR, carotid protuberance and optic protuberance were observed bilaterally in all of the five cadavers. MOCR was clearly observed in all cadavers on the right side and in four out of five cadavers on the left side.

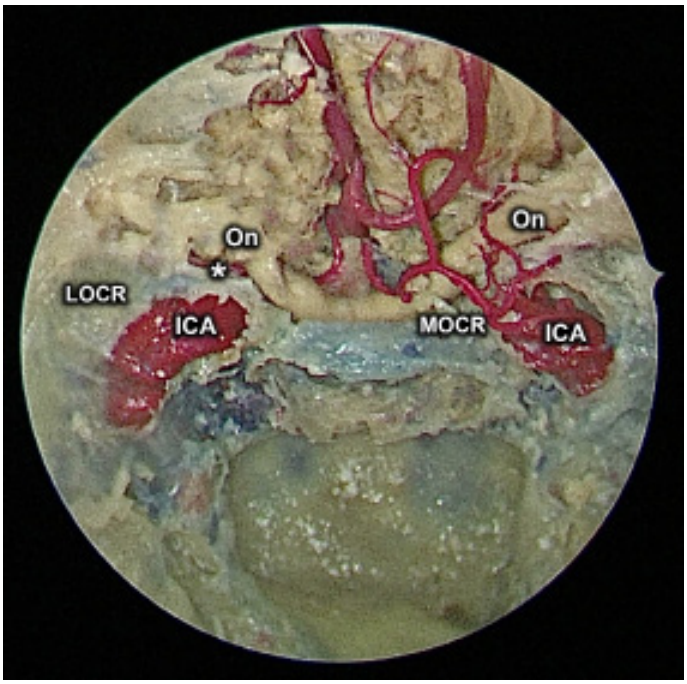
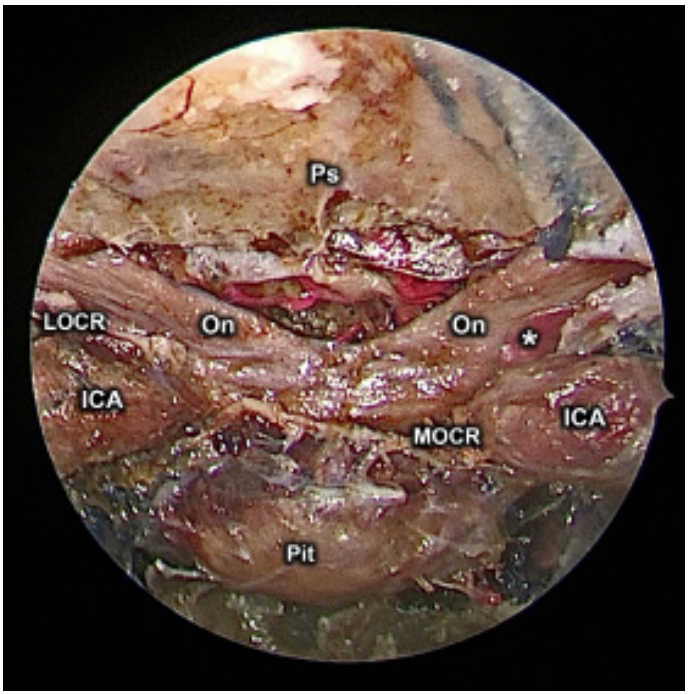


Figure 1: Opticocarotid region. The optic nerve decompression was performed bilaterally and internal carotid arteries were skeletonized. MOCR: Medial opticocarotid recess, LOCR: Lateral opticocarotid recess, On: Optic Nerve, ICA: Internal carotid artery, *: Ophthalmic artery



The superior border of the LOCR ranges between a minimum of 3.22 mm and a maximum of 7.28 mm (mean 4.85±1.94 mm) on the right side and between a minimum of 2.37 mm and a maximum of 5.48 mm (mean 3.93±1.11 mm) on the left side (Table 1).

Table 1: The measurements of superior border of LOCR

	Right (mm)	Left (mm)
Cadaver 1	6.10	5.48
Cadaver 2	7.28	4.02
Cadaver 3	3.64	4.19
Cadaver 4	3.22	2.37
Cadaver 5	4.01	3.61
Average	4.85±1.94	3.93±1.11

The superior border of the LOCR ranges between a minimum of 2.09 mm and a maximum of 6.92 mm (mean 4.72±2.11 mm) on the right side and between a minimum of 1.79 mm and a maximum of 6.41 mm (mean 3.98±1.67 mm) on the left side (Table 2).

Table 2: The measurements of inferior border of LOCR

	Right (mm)	Left (mm)
Cadaver 1	6.92	6.41
Cadaver 2	6.88	4.32
Cadaver 3	3.78	4.08
Cadaver 4	2.09	3.33
Cadaver 5	3.95	1.79
Average	4.72±2.11	3.98±1.67

The linear distance between LOCR and MOCR ranges between a minimum of 1.97 mm and a maximum of 5.25 mm (mean 3.11±1.41 mm) on the right side and between a minimum of 1.61 mm and a maximum of 4.49 mm (mean 2.46±1.36 mm) on the left side (Table 3).

Table 3: The measurement of the distance between LOCR and MOCR. *: In Cadaver 3, MOCR could not be determined on the left side and therefore it could not be measured.

	Right (mm)	Left (mm)
Cadaver 1	5.25	4.49
Cadaver 2	3.89	2.08
Cadaver 3	1.97	-*
Cadaver 4	2.24	1.61
Cadaver 5	2.24	1.66
Average	3.11±1.41	2.46±1.36

Discussion

In the literature, many landmarks have been described that can be used during the approaches to the sellar and opticocarotid regions [1,4,8,9]. Optic nerve is a cone-shaped projection on the superolateral wall of the sphenoid sinus during the endoscopic approach [8]. LOCR, an important anatomical landmark used to identify the optic nerve, is the pneumatisation of the optic strut that separates the optic canal from the superior orbital fissure, and it is more prominent compared to MOCR [1,8]. Locatelli et al. defined LOCR as the most prominent anatomical landmark in determining the

optic nerve, the internal carotid artery and the ophthalmic artery [10]. Li et al emphasized that the superior and lateral walls of the sphenoid sinus can be confused with optic protuberance in endoscopic views, and therefore LOCR is a stronger predictor than the optic protuberance [7]. In this study LOCR, carotid protuberance and optic protuberance were identified bilaterally in all five cadavers.

LOCR has a triangular shape and borders of this triangle are determined by optic nerve superiorly, internal carotid artery inferiorly and orbital apex and inferior orbital fissure laterally [8]. The optic nerve has four segments: intracranial, intracanalicular, intraorbital and intraocular [11]. The length of the superior border of the LOCR corresponds to the intracanalicular part of the optic nerve. In this study, the mean length of the superior border was measured as 4.85±1.94 mm on the right side and 3.93±1.11 mm on the left side.

The clinoidal part of the internal carotid artery is located on the inferior part of the LOCR (Figure 2). Internal carotid artery injury is one of the most serious complications that can be encountered during optic nerve decompression via endonasal endoscopic approach. In this study, the mean length of the inferior border was measured as 4.72±2.11 mm on the right side and 3.98±1.67 mm on the left side.

MOCR is a teardrop-shaped bony recess. It corresponds to the medial intersection of the paraclinoid carotid canal and the preforaminal segment of the optic nerve [8]. According to the study by Yilmazlar et al, MOCR is the least prominent anatomical landmark in the sphenoid sinus and could be detected at 25 of 30 cadavers on the right side and 22 of 30 on the left side [4]. Ozcan et al stated in their study that the reveal of MOCR provided the preservation of subchiasmatic and infundibular branches during dissection [12]. In this study by Ozcan et al, MOCR was determined in 24 of 29 cadavers on the right side and in 19 of 29 cadavers on the left side [12]. In our study, MOCR was clearly observed in all of the cadavers on the right side and in 4 of the 5 cadavers on the left side.

Ozcan et al defined a prominent sulcus between MOCR and LOCR [12]. The decompression of the optic canal can be achieved by following this sulcus, which is located between the optic nerve and the internal carotid artery [4]. Ozcan et al classified the cadaver specimens with a distance less than 3 mm between LOCR and MOCR as Type 1 and the cadaver specimens with a distance more than 3 mm as Type 2 [12]. According to this study, 19 of 29 cadavers were classified as Type 1 on the right side and in these specimens, the average distance between LOCR and MCOR was measured as 2.26±0.50 mm. In the same study, 10 of 29 cadavers were classified as Type 2 on the right side and the average distance between LOCR and MOCR was measured as 6.64±0.10 mm. On the left side, 17 of 29 cadavers were classified as Type 1 and the average distance between LOCR and MOCR was measured as 2.26±0.40 mm on the left side. 12 of 29 cadavers were classified as Type 2 and the average distance between LOCR and MOCR was measured as 6.79±0.90 mm on the left side [12]. In this study, the mean distance between LOCR and MOCR was 3.11±1.41 mm on the right side and 2.46±1.36 mm on the left side. Additionally, anatomical exposure of the optic canal and the orbital apex is very important, and major complications can be reduced and previous results affecting outcomes were recently reported [13].

Conclusion

Optic nerve and optic canal can be affected by many sellar and parasellar pathologies such as tumors, trauma, infections, vascular pathologies and inflammatory processes. Anatomical landmarks located in the sphenoid sinus play a major role during endonasal endoscopic surgery to this region. To be able to reveal these landmarks and to know the detailed anatomy of this region is necessary for a safe surgery.

Conflict of interest

None

Financial suppor

None

Ethical Approval

Conducting scientific studies on cadavers or cadaveric body parts, contribution to education and science is not “human subjects” research and do not require ethical approval. The authors would like to express their sincere gratitude to the donors and their families for their and does not require review IRB review and approval.

Author Contributions

Tugba Morali Guler, Gokmen Kahilogullari, Ayhan Comert wrote the main manuscript text. Tugba Morali Guler, Hazan Basak, Yigit Gungor, Mehmet Yilmaz, Suha Beton, Gokmen Kahilogullari, Ayhan Comert collected the data. Tugba Morali Guler, Gokmen Kahilogullari, Ayhan Comert analyzed the data, and all authors reviewed the manuscript.

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