ARAŞTIRMA MAKALESİ/ ORIGINAL ARTICLE

Kocaeli Med J 2018; 7; 3:130-134

Cerrahi yaklaşım açısından hipofizer fossa ile ilişkili yapıların morfometrik analizi

Morphometric Analysis of Hypophyseal Fossa Related Structure; in Terms of Surgical Approach

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ÖZ

GİRİŞ ve AMAÇ: *Kafa tabanının morfometrik ve topografik anatomisinin önemi birçok nöroşirürji ve radyoloji yazısında yer almaktadır. Çalışmamızın amacı cerrahi koridorları tanımlamak ve cerrahi yaklaşımda güvenli mesafeler oluşturulmasına yardımcı olunmasını sağlayacak ortalama mesafelerin belirlenmesidir.*

YÖNTEM ve GEREÇLER: *Dokuz Eylül Üniversitesi Tıp Fakültesi Anatomi Anabilim Dalı Laboratuvarına ait 16 adet kuru kemik cranium incelendi. Tüm kafatası tabanlarında foramen lacerum, foramen rotundum, foramen ovale, fossa hypophysialis, processus clinoideus anterior ve processus clinoideus posterior belirlendi ve bu parametreler arasındaki mesafeler dijital Vernier kumpas ile ölçüldü.*

BULGULAR: *Foramen rotundum'un sağ taraftaki processus clinoideus anterior'a olan uzaklığı soldan daha büyüktü (p: 0,41). Foramen ovale'nin sol taraftaki processus clinoides posterior'a olan uzaklığı sağdan daha büyüktü (p: 0.010). Diğer parametrelerde sol ve sağ taraflar arasında istatistiksel olarak anlamlı fark yoktu.*

TARTIŞMA ve SONUÇ: *Operasyonlar sırasında komplikasyonlar ortaya çıksa da bölgesel anatomiye hakim olunması; ölüm ve morbidite insidansını azaltmaktadır. Yapmış olduğumuz morfometrik ve topografik değerlendirmelerimizin cerrah ve radyologlara rehberlik edeceğine inanmakla birlikte daha geniş ve çok merkezli serilere ihtiyaç vardır.*

Anahtar Kelimeler: *morfometri, kafa tabanı, nöroşirurji*

ABSTRACT

INTRODUCTION: *The importance of knowledge regarding both the anatomy and the structures of the skull base are cited in many neurosurgery and radiology papers. Therefore, the purposes of our study were to identify the surgical corridors and to determine the mean distances to help establish the safest distances for surgical approaches.*

METHODS: *We examined 16 dry human skulls of unknown gender that belonged to the Anatomy Department Laboratory of Dokuz Eylul University Medical School. Foramen lacerum (FL), foramen rotundum (FL), foramen ovale (FO), hypophyseal fossa, anterior clinoid process (ACP) and posterior clinoid process (PCP) were determined in all skull bases and distances between these parameters were recorded with digital Vernier caliper which was accurate to millimeters.*

RESULTS: *The FR's distance to the ACP on the right side was greater than on the left side (p: 0.41). The FO's distance to the PCP on the left side was greater than on the right side (p: 0.010). There were no other statistically significant differences between the left and right sides.*

DISCUSSION and CONCLUSION: *Although complications can occur, improved familiarity with the regional anatomy would lower incidences of death and morbidity during surgeries. While we believe that our morphometric and topographic evaluations will help guide surgeons and radiologists, wider series and multi-center studies should be done.*

Keywords: *morphometry, skull base, neurosurgery*

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Başvuru Tarihi: 29.05.2018
Kabul Tarihi: 30.09.2018

INTRODUCTION

Both morphometric and topographic evaluations of the skull base are vital for surgeons, with the key point being the sphenoid bone (1). The sphenoid bone lies within the central skull base and consists of the foramen ovale (FO), the foramen rotundum (FR), the anterior clinoid process (ACP), the posterior clinoid process (PCP), and the hypophyseal fossa (HF) (2). Anteriorly, the paired ACPs arise from the medial aspects of the lesser sphenoid wings and project laterally to each side of the sella turcica. Posteriorly, the PCPs arise at the lateral margins of the dorsum sella and project anteriorly (1–2). The clinoid processes provide attachments for important dural reflections, which make them critical in fossa cranii media tumor surgery as well as pituitary surgery (3). The FO transmits to the mandibular nerve, the lesser petrosal nerve, and the accessory nerve, while the FR transmits to the maxillary nerve through the skull. By contrast, the foramen lacerum (FL), which is the foramina that is made by three bones (sphenoid, temporal, and occipital), has a close relationship with the internal carotid artery (2). Knowledge of these foramens' anatomy and the structures that are located nearby has been cited as extremely important in many neurosurgery and radiology papers (4–7).

The HF protects the pituitary gland, which plays a major role in regulating vital body functions, even though it is small in size (8). Detailed knowledge of its surroundings, such as neural, vascular, and bony anatomy, is crucial for neurosurgeons because injury to any of the above mentioned structures during surgeries can cause irreversible morbidity (6).

The current literature lacks sufficient data about the distance between these parameters. Therefore, we sought to identify the surgical corridors while planning an exact approach to the pathology in this area by determining the mean distances, which will help establish the safest distances for surgical approaches.

METHODS

We examined 16 dry human skulls of unknown gender that belonged to the Anatomy Department Laboratory of Dokuz Eylul University Medical School. Although the exact ages of the skulls were unknown, they were accepted as adults per visible teeth eruption. Official permission for this research was obtained from the Dokuz Eylul University Medical School Ethics Committee. None of the examined skulls showed signs of prior cranial surgery, malformation, or trauma, and all specimens were photographed with a Canon EOS 700D (55 mm objective) camera.

The evaluated study parameters included the closest distance between the following: the tip of the right ACP and the right FL; the left ACP and the left FL; the right PCP and the right FL; the left PCP and the left FL; the right ACP and the right FR; the left ACP and the left FR; the right PCP and the right FR; the left PCP and the left FR; the right ACP and the right FO; the left ACP and the left FO; the right PCP and the right FO; the left PCP and the left FO; the right margin of the HF and the right FL; the left margin of the HF and the left FL; the right margin of the HF and the right FR; the left margin of the HF and the left FR; the right margin of the HF and the right FO; the left margin of the HF and the left FO.

Minimum distances were measured between these parameters for each specimen. All measurements were recorded with a digital Vernier caliper, which was accurate to the millimeter (mm).

Statistical Analysis

The testing results were expressed as the number of observations (n), the minimum and maximum values (min-max), and the mean standard deviation (Mean ± SD). SPSS 22.0 (SPSS Inc, Chicago, IL) was used for both the descriptive and analytic statistical analyses of the collected data. The student's t test was used to assess the difference between the sides.

RESULTS

The FL, FR, FO, HF, ACP, and PCP were identified in all skull bases. The distances between these parameters and left-right variations were given in Tables 1 and 2. The FR's distance to the ACP on the right side was greater than on the left side (t: 2.232; p: 0.41).

The FO's distance to the PCP on the left side was greater than on the right side (t: -2,960; p: 0.010). There were no other statistically significant differences between the left and right sides.

Table 1. Anterior and Posterior Clinoid processes related parameters

	Right		Left		
Parameters (n:16)	Min-Max (mm)	Mean±SD (mm)	Min-Max (mm)	Mean±SD (mm)	P values
FL-PCP	3,95-10,03	6,62±2,05	2,9-10,02	6,42±2,09	,548
FL-ACP	8,28-15,84	11,62±1,92	8,7-15,63	11,45±2,22	, 635
FR-PCP	10,12-20,46	14,95±2,90	10,35-19,75	15,28±2,96	,612
FR-ACP	9,57-14,49	11,23±1,39	8,27-13,96	10,54±1,92	**,041**
FO-PCP	15,11-24,10	18,75±2,51	16,20-26,05	19,76±2,67	**,010**
FO-ACP	15,75-28,42	19,05±3,11	15,48-25,54	19,11±3,01	,914

FL: foramen lacerum; PCP: posterior clinoid process; ACP:anterior clinoid process; FR: foramen rotundum; FO: foramen ovale; P values were given for the comparisons between the right and left sides

Table 2. Hypophyseal fossa related parameters

Parameters (n:16)	Min-Max (mm)	Mean±SD (mm)	p value
RMHF-FL	3,86-11,38	5,62±1,88	,663
LMHF-FL	2,88-7,91	5,40±1,56	
RMHF-FR	6,37-14,62	10,85±2,66	,059
LMHF-FR	6,85-19,96	12,10±3,43	
RMHF-FO	17,57-23,93	19,65±2,01	,370
LMHF-FO	17,68-27,86	20,14±2,51	

RMHF: right margin of hypophyseal fossa; LMHF: left margin of hypophyseal fossa; FL: foramen lacerum; FR: foramen rotundum; FO: foramen ovale; P values were given for the comparisons between the right and left sides

DISCUSSION

Middle cranial fossa surgeries, such as pituitary surgeries, become more feasible with endoscopic approaches, making knowledge of skull base morphometry and topography even more crucial. In addition, familiarity with the anatomy and surgical landmarks of middle cranial fossa will permit the proper display and appreciation of regional pathologic processes to facilitate diagnosis and medical/surgical management of sellar/parasellar diseases.

The PCP, which has several surrounding structures, such as the internal carotid, the basilar and the posterior communicating arteries, and the oculomotor and trochlear nerves, has a unique location in the center of the skull base, which makes it a useful surgical landmark (9,10). However, the PCP'S anatomy and surrounding structures have received less attention than the ACP's anatomy in the neurosurgical literature (11).

The FR and the FO represent the most lateral borders of extended transnasal approaches; therefore, the distances between these anatomical landmarks to the PCP represent the limits of the lateral surgical approach (10). Knowing the FO-PCP distance can also help minimalize complications during puncture of the FO, which is used to alleviate trigeminal neuralgia (12–13). We reported these distances and also found that the FO's distance to the PCP on the left side was greater than on the right side (p: 0.010). In addition, knowledge of the topographic anatomy of the FO and the FR is important during cavernous sinus operations, which are performed by the lateral approach, to avoid certain complications, such as trigeminal nerve injury and internal carotid artery injury (14).

Notably, our measured distances provide a general idea of the distances between the most commonly used landmarks for surgical skull base approaches (9, 15–16).

Dogan et al. observed 44 adult dry human skulls and reported that the right FR-ACP distance (10.88 ± 3.65) was higher than the left FR-PCA distance (11.27 ± 2.09), and it was correlated with our results (11.23 ± 1.39 on the right side; 10.54 ± 1.92 on the left side) (17).

Chowdhury et al. reported on immediate postoperative complications in transsphenoidal pituitary surgery. They reviewed the cases of 152 patients who had undergone sub-labial transsphenoidal surgery by surgeons with a minimum of six years of experience. Of the 152 cases, 21 complications that could have been caused by damage to the surrounding structures, such as vision loss, new cranial nerve palsy, and bleeding/hematoma, were observed (18).

In another example, Ivan et al. conducted a survey about transsphenoidal surgery complications with 1,162 surgeons. They reported 128 deaths and hundreds of complications that were associated with damage to surrounding structures. The participating surgeons were divided into 3 groups per their operation experience by number of cases:

< 200, 200–500, and > 500. They concluded that, although complications can occur, a better understanding of the indications for transsphenoidal surgery and improved familiarity with the regional anatomy would lower incidences of death and morbidity that result from this procedure (19).

CONCLUSION

Although we believe that our morphometric and topographic evaluations will help guide surgeons and radiologists, wider series and multi-center studies should be done to identify reliable landmarks for the base of the cranium and to help standardize certain dimensions.

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