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Evaluation of the Relationship between Childhood Adenoid Tissue and Subcutaneous Fat Tissue Using MRI

Çocukluk Çağı Adenoid Dokusu ve Deri Altı Yağ Dokusu İlişkisinin MRG Kullanılarak Değerlendirilmesi

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ÖZ

Amaç: Bu çalışmada, çocuk hastalarda boyun bölgesindeki deri altı yağ dokusu kalınlığı ile nazofaringeal hava geçişi arasındaki ilişkinin manyetik rezonans görüntülemede (MRG) ile değerlendirilmesi amaçlanmıştır.
Araçlar ve Yöntem: Çalışmamızda Haziran 2018 ile Aralık 2018 tarihleri arasında herhangi bir nedenle beyin manyetik rezonans görüntüleme (MRG) yapılan 4-6 yaş arası 93 çocuğun (46 erkek ve 47 kadın) tıbbi görüntüleme kayıtları adenoid doku kalınlığı ve oksipital deri altı yağ dokusu kalınlığının değerlendirilmesi amacıyla geriye dönük olarak incelendi. Bu amaçla hastalardan son bir yıl içinde alınan tek düzlemli (sagital düzlem) hızlı sıralı MRG görüntüleri kullanıldı.
Bulgular: Çalışmaya 46(%49.5) erkek ve 47(%50.5) kadın olmak üzere toplam 93 olgu dahil edildi. Cinsiyete göre nazofaringeal adenoid doku kalınlıkları ile oksipital bölge subkutan yağ doku kalınlıkları arasında istatistiksel olarak anlamlı bir fark gözlenmedi. Ortalama adenoid doku kalınlığı erkeklerde 9.8±2.13 mm iken kadınlarda 9.25±1.74 mm olarak ölçüldü (p=0.178). Oksipital bölgeden elde edilen ortalama deri altı yağ dokusu kalınlığı erkeklerde 5.65±1.26 mm, kadınlarda ise 5.84±1.28 mm olarak bulundu (p=0.465). Ancak, oksipital deri altı yağ dokusu kalınlığı, adenoid doku kalınlığı (Rho=0.488 p=0.000) ve nazofaringeal hava yolu darlığı yüzdesi (Rho=0.482 p=0.000) arasında orta derecede pozitif korelasyon bulundu.
Sonuç: Oksipital subkutan yağ dokusu kalınlığı ve adenoid doku kalınlığı arttıkça nazofaringeal hava yolunun önemli ölçüde daraldığı gözlendi.

Anahtar Kelimeler: adenoid; MRG; obezite; pediatri; uyku apnesi

ABSTRACT

Purpose: In this study, it was aimed to evaluate the relationship between subcutaneous fat tissue thickness in the neck region and nasopharyngeal air passage in pediatric patients with magnetic resonance imaging (MRI).
Materials and Methods: In our study, medical imaging records of 93 children (46 male and 47 female) aged between 4-6 years, who underwent brain magnetic resonance imaging (MRI) for any reason between June 2018 and December 2018, were retrospectively examined on the purpose of evaluation of adenoid tissue thickness and occipital subcutaneous fat tissue thickness. Single plane (sagittal plane) rapid sequence MRI images taken from the patients within the last one year were used for this purpose.
Results: A total of 93 cases, 46(49.5%) male and 47(50.5%) female, were included in the study. No statistically significant difference was observed in nasopharyngeal adenoid tissue thickness and occipital region subcutaneous fat tissue thicknesses according to gender. While the mean adenoid tissue thickness was 9.8±2.13 mm in men, it was measured as 9.25±1.74 mm in women (p=0.178). The mean subcutaneous fat tissue thickness obtained from the occipital region was 5.65±1.26 mm in male, whereas it was found to be 5.84±1.28 mm in women (p=0.465). However, a significant moderate positive correlation was found between the occipital subcutaneous fat tissue thickness, adenoid tissue thickness (Rho=0.488 p=0.000) and the percentage of nasopharyngeal air passage stenosis (Rho=0.482 p=0.000).
Conclusion: The nasopharyngeal air passage was observed to be significantly narrowed as occipital subcutaneous fat tissue thickness and adenoid tissue thickness increased.

Keywords: adenoid; MRI; obesity; pediatric; sleep apnea

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INTRODUCTION

Adenoid tissue, along with other lymph tissues (Waldeyer ring) that surround the part of the oropharynx and nasopharynx, serves as the primary defense system at the anterior opening part of the pharynx.[1] While lymphoid tissues (especially adenoids and tonsils) grow rapidly in childhood, they stop growing and even shrink in puberty and young adulthood.[2] In the case of adenoid hypertrophy, the disturbance in nasal airflow leads to obstruction in the nasopharyngeal airway.[3] In childhood, adenoid hypertrophy accompanies many other clinical conditions as well, such as disruption in sleep patterns, growth retardation, poor school performance, and pediatric obstructive sleep apnea hypopnea syndrome (OSAHS).[1,3-6] The relationship between adenoid hypertrophy and the development of OSAHS, caused by the growth of adipose tissue in the pharynx and neck region, has already been noted, especially in obese pediatric patients.[7] Moreover, obesity and adenoid hypertrophy have already been defined as risk factors for the growth of OSAHS.[7-9] Although lateral cephalometric radiography is a common method to evaluate the adenoid size,[7,10] there is no specifically established guideline yet which can be used to evaluate adenoid hypertrophy and upper airway narrowing.[11] Nasoendoscopy (gold standard), rhinomanometry, acoustic rhinometry, computed tomography, and magnetic resonance imaging (MRI) methods are some other testing methods that are used in the diagnosis of adenoid hypertrophy.[3,11]

In this study, we aimed to study the relationship between subcutaneous adipose tissue thickness and adenoid dimensions as an indicator of obesity in rapid sequence MRI in single plane (sagittal plane) because of its supremacy in the studies of soft tissue planes. Therefore, we investigated the role of rapid-sequence MRI in a single plane (sagittal plane) in adenoid size and upper airway obstruction, particularly because of its supremacy in the studies of soft tissue planes and due to the absence of the X-ray method.

MATERIALS and METHODS

The study is a retrospective study conducted on registered archive information. This manuscript is exempted from obtaining informed consent. The study protocol was approved by the ethical committee of Adıyaman University (decision date: 20.11.2018, IRB number: 2018/8-29).

Study Population

In our study, medical imaging records of 4-6 years old pediatric patients, who underwent brain magnetic resonance imaging (MRI) for any reason between June 2018 and December 2018, were retrospectively analyzed based on the purpose of evaluating adenoid tissue thickness and occipital subcutaneous fat tissue thickness. Single plane (sagittal plane) rapid sequence MRI images, taken from the patients within last one year, were used for this purpose.

- ✓ Those who have had nasal, nasopharyngeal, or adenoidectomy surgery;
- ✓ Those with a pathology that might close the nasal passage such as septum deviation, concha bullosa and nasal polyp;
- ✓ Image records of patients with antrochoanal polyps, cystic fibrosis, and choanal atresia were excluded from the study.

Sample Size Calculation

A total of 130 pediatric patients’ image record was analyzed. Only 93 patients, who have gone through MRI, were included in the study. A post-hoc power analysis was done based on the primary outcome variable, which was adenoid tissue thickness. A total sample size of 96 patients (48 male+48 female) provides 80.0% of power to compare the mean adenoid tissue thickness in two independent groups with an effect size of 0.5, an alpha error of 5%, and a two-tailed hypothesis.[12]

Method of Measurement

In all cases, the MRI images were obtained using the 1.5 Tesla magnetic field strength Philips Achieva MR device (Philips Medical System, Best, Netherlands) with a head coil. A section from the cranial midline, where the thickest part of the adenoid tissue can be seen in the sagittal plane, was selected from T1-weighted images for the analysis (time to repeat (TR):497 ms, time to echo (TE): 12 ms, FOV: 220X230, slice thickness: 5 mm, matrix: 290X214, NSA: 1, gap: 1mm, voxel: 0.75x1.07x5, slices: 22 section) (Figure 1).

Figure 1. MRI adenoid tissue thickness and occipital subcutaneous fat tissue thickness

Moreover, the percentages of occipital subcutaneous fat tissue thickness, nasal passage width and nasopharyngeal stenosis were calculated. MRI evaluation and measurements were performed by an experienced radiologist.

Statistical Analysis

SPSS 21.0 software was used for statistical analyses (SPSS Inc., Chicago, IL, USA). Categorical data of the cases in this study were expressed as numbers and percentages. The Shapiro-Wilk's test was applied for the evaluation of normal distribution. Data that have none-normal distribution was expressed as median, minimum, and maximum while data showing normal distribution were stated as mean±standard deviation. While Mann-Whitney U test was used to evaluate the distribution of nonparametric data between the groups, the distribution of parametric data was evaluated with the Independent Samples t-test. The correlation between numerical data was analyzed through Spearman and Pearson correlation analyses. Correlation coefficient; for Spearman's test, Rho values less than 0.2-0.4 were considered as weak correlation; values between 0.4-0.6 were moderately correlation; between 0.6-0.8 were strongly correlation; between of 0.8-1.0 were considered as very strong correlation. The statistical significance threshold was defined as a p-value <0.05.

RESULTS

A total of 93 children, who underwent brain MRI for any reason, were included in the study. A total of 93 cases, 46(49.5%) male and 47(50.5%) female, were included in the study. 37(39.8%) of the cases were four-year-old, 42(45.2%) of them were five-year-old, and 14(15.1%) cases were six-year-old.

The mean nasopharyngeal adenoid tissue thickness was noted as 9.52±1.95 mm. While the mean adenoid tissue thickness was 9.8±2.13 mm in men, it was measured as 9.25±1.74 mm in women (p=0.178). The mean subcutaneous fat tissue thickness obtained from the occipital region was 5.65±1.26 mm in men, whereas it was found to be 5.84±1.28 mm in women (p=0.465). The mean percentage of nasopharyngeal air passage stenosis is 63.76, a minimum of 27.04, and a maximum of 82.72. While the percentage of air passage stenosis was 63.39±10.36 in men, it was 60.28±11.01 in women (p=0.153). No statistically significant difference was observed in nasopharyngeal adenoid tissue thickness and occipital region subcutaneous fat tissue thicknesses across gender groups (Table 1).

Table 1. Comparison of the percentage rates of nasopharyngeal adenoid tissue thickness, nasal passage width, occipital region subcutaneous fat tissue thickness and nasopharyngeal air pas-sage stenosis according to gender

Variables	Male n=46	Female n=47	Total n=93	P value
*Adenoid tissue thickness	9.8±2.13	9.25±1.74	9.52±1.95	p=0.178
**Occipital subcutaneous fat thickness	5.65±1.26	5.84±1.28	5.74±1.26	p=0.465
***Percentage of Nasopharyngeal air passage stenosis	63.39±10.36	60.27±11.01	61.81±10.75	p=0.153
****Nasal passage width	15.38±1.65	15.4±1.34	15.39±1.49	p=0.178
Age (Mean±SD)	4.67±0.66	4.83±0.73	4.75±0.70	/
Age (Median; min-max)	5(4-6)	5(4-6)	5(4-6)	/

* Adenoid tissue thickness of male and female: t=1.356, p=0.178
** Occipital subcutaneous fat thickness of male and female: t=0.733 p=0.465
*** Nasopharyngeal air passage stenosis percentage for male and female: Z=1.479 p=0.153
**** Nasal passage width for male and female: t=1.356 p=0.178

Nasal passage width was determined to have a moderate positive correlation with adenoid tissue thickness (p<0.0001, r=0.545). However, no significant correlation was found between occipital region subcutaneous fat tissue thickness and nasopharyngeal air passage width (p=0.111 r=0.166). A significant moderate positive correlation was also determined among the occipital subcutaneous fat tissue thickness, adenoid tissue thickness and the percentage of nasopharyngeal air passage stenosis.

Furthermore, it was determined that there was a very strong positive correlation between adenoid tissue thickness and the percentage of nasopharyngeal air passage stenosis (Table 2).

As the occipital subcutaneous fat tissue thickness and adenoid tissue thickness increased, nasopharyngeal air passage was observed to significantly narrow (Figure 2-4).

Table 2. Findings related to correlation analysis in numerical data

Variables	Adenoid tissue thickness	Total nasal passage width	Suboccipital subcutaneous fat tissue thickness
Total nasal passage width	p<0.0001 Rho=0.545	Rho=1	p=0.111 Rho=0.166
Suboccipital sub-cutaneous fat tissue thickness	p<0.0001 Rho=0.488	p=0.111 Rho=0.166	Rho=1
Percentage of nasopharyngeal air passage stenosis*	p<0.0001 Rho=0.829	p=0.091 Rho=0.387	p<0.0001 Rho=0.535

*Nonparametric correlation analysis (Spearman's Rho test analysis) was used since the percentage of nasopha-ryngeal air passage stenosis doesn't show a normal distribution (Shapiro Wilks test, p=0.003) (n=93).

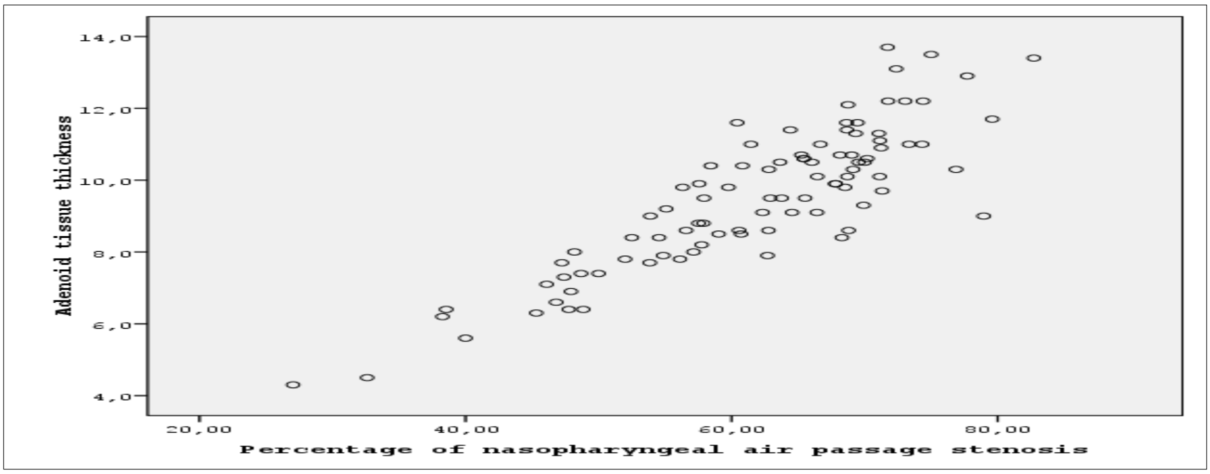

Figure 2. Scatterplot of adenoid tissue thickness and the percentage of nasopharyngeal air passage stenosis

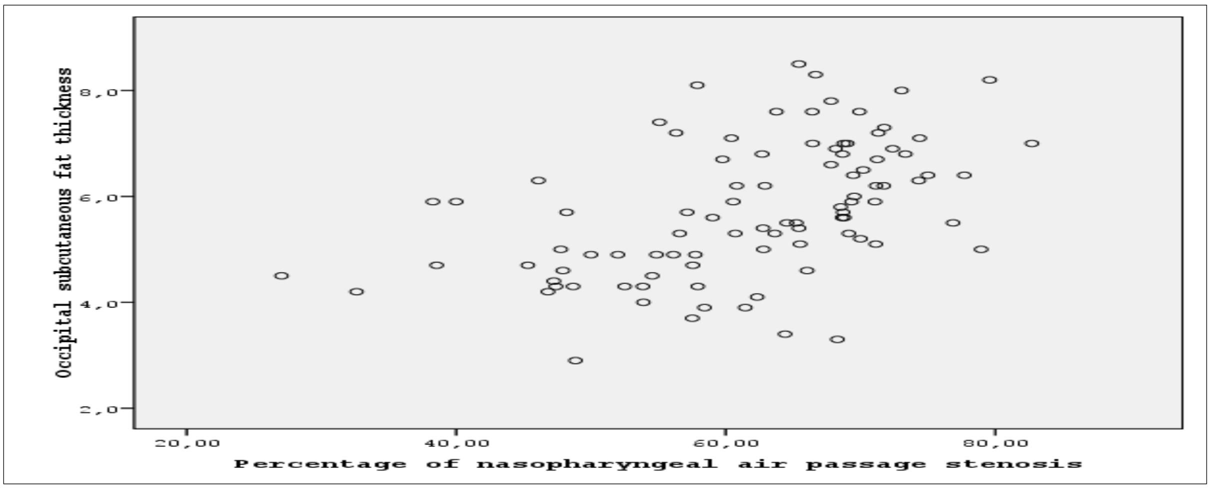

Figure 3. Scatterplot of occipital subcutaneous fat thickness and the percentage of nasopharyngeal air passage stenosis

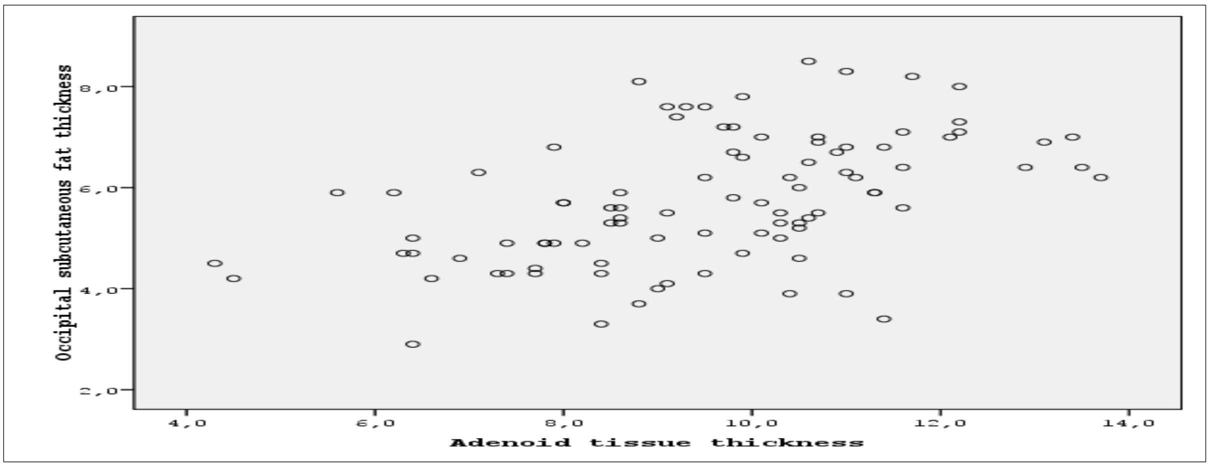

Figure 4. Scatterplot of occipital subcutaneous fat thickness and adenoid tissue thickness

DISCUSSION

The adenoid is a group of lymphoid tissues located in the upper part of the nasopharyngeal cavity, at the base of the sphenoid.[13] Adenoid tissue is there since the birth and it continues to grow with age. It reaches its maximum level at the age of about 6 and later it starts to degenerate. Degeneration generally starts after 10 years of age and completely disappears at puberty.[14] According to Pruzansky, the largest size of adenoid was seen at the age of 4-6 years in his radiological measurements.[15] Therefore, Pediatric patients aged 4-6 years were included in our study.

Adenoid hypertrophy is commonly seen in childhood. In childhood, adenoid hypertrophy leads to upper airway obstruction as it fills the nasopharynx. This causes mouth breathing, nasal draining, and sleep disorders such as sleep apnea.[16] Obstructive sleep apnea hypopnea syndrome (OSAHS) is a respiratory disorder which is characterized by the collapse of the upper airway. Its prevalence in childhood is 1-2%, and is most commonly caused due to adenotonsillar hypertrophy (ATH). However, obesity along with adenotonsillar hypertrophy represents one of the main risk factors for OSAHS in children.[17]

Adipose tissue stored in the pharynx and neck region in obese children plays a critical role in the growth of OSAHS together with adenoid and tonsil hypertrophy.[9] Based on this, by comparing adenoid tissue thickness and occipital subcutaneous fat tissue thickness through MRI images, we aimed to explore the relationship between obesity and adenoid tissue thickness and stenosis that might occur in the nasopharyngeal air passage. We evaluated the relationship between subcutaneous adipose tissue thickness, which is an important indicator of obesity, and adenoid tissue thickness with MRI imaging method due to its well-known superiority in soft tissues studies. As a result, a positive correlation was determined between adenoid tissue thickness and subcutaneous fat tissue thickness.

In the study of Daar et al., the rate of adenoid and tonsil hypertrophy was found to be higher in obese children compared to non-obese children.[7] The study by Kang et al. showed that the coexistence of obesity and adenoid hypertrophy in the preschool age group significantly increased the risk of OSAHS.[8]

Patient's clinical complaints, endoscopy and lateral radiographs are widely used by physicians to identify adenoid hypertrophy.[18] Radiologically, several methods have been used to show the measurement of adenoid tissue yet none of them have been accepted or applied widely. measurements haven’t been sufficient to express the maximum thickness of the nasopharyngeal tissue.[19] In the study of Wang et al., it was shown that ultrasonography can be used in adenoid hypertrophy diagnosis and post-operative follow-ups.[13]

However, there is not any study in the literature that has used MRI as a method for measuring the dimensions of adenoid tissue and nasopharyngeal airway patency. MRI not only has the superiority in the evaluation of adenoid tissue, especially in showing the soft tissues and its pathologies, but also it is important not to use X-rays as a method in pediatric patients.

In conclusion, we think that MRI analysis in a single plane (sagittal plane) will make an important contribution to the literature in the diagnosis and treatment protocol of adenoid hypertrophy along with other childhood pathologies which might occur due to adenoid hypertrophy. Due to the limited number of patients and the retrospective nature of the study, related future studies involving a larger population will contribute significantly to the literature.

The limitation of the study is that the study was conducted in a retrospective design, and polysomnography could not be performed in the included cases due to the current pandemic conditions; therefore, it could not be clearly stated whether the patients had sleep apnea or not. In this sense, prospective studies in children diagnosed with sleep apnea by polysomnography will significantly contribute to this issue in line with the results of our study.

Conflict of Interest

The authors declare that there is not any conflict of interest regarding the publication of this manuscript.

Ethics Committee Permission

The study protocol was approved by the ethical committee of Adıyaman University (decision date: 20.11.2018, IRB number: 2018/8-29).

Authors' Contributions

Concept/Design: MS, MK. Data Collection and/or Processing: MK, IHB. Data analysis and interpretation: MS, MK. Literature Search: MS, MK, IHB. Drafting manuscript: MK. Critical revision of manuscript: MS, IHB. Supervision: MS, MK, IHB.

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