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Supplement

Solca M. Acute pain management: Unmet needs and new advances in pain management. Eur J Anaesthesiol 2002; 19(Suppl 25): 3-10.

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Online article not yet published in an issue

Butterly SJ, Pillans P, Horn B, Miles R, Sturtevant J. Off-label use of rituximab in a tertiary Queensland hospital. Intern Med J doi: 10.1111/j.1445-5994.2009.01988.x

Book

Sample1: Murray PR, Rosenthal KS, Kobayashi GS, Pfaller MA. Medical microbiology. 4th ed. St. Louis: Mosby; 2002.

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Chapter in a book

Meltzer PS, Kallioniemi A, Trent JM. Chromosome alterations in human solid tumors. I n: Vogelstein B, Kinzler KW, editors. The genetic basis of human cancer. New York: McGraw-Hill; 2002. p. 93113.

Journal article on the Internet

Abood S. Quality improvement initiative in nursing homes: The ANA acts in an advisory role. Am J Nurs [serial on the Internet] 2002 [cited 12 Aug 2002]; 102. Available from: www.nursingworld.org/AJN/2002/june/wawatch.htm

Website

Cancer-pain.org [homepage on the Internet]. New York: Association of Cancer Online Resources [updated 16 May 2002; cited 9 Jul 2002]. Available from: www.cancer-pain.org

An organization as an author

The Intensive Care Society of Australia and New Zealand. Mechanical ventilation strategy in ARDS: Guidelines. Int Care J Aust 1996;164:282-4.

Acknowledgements

The source of financial grants and the contribution of colleagues or institutions should be acknowledged.

Tables

Tables should be complementary, but not duplicate information contained in the text. Tables should be numbered consecutively in Arabic numbers, with a descriptive, self-explanatory title above the table. All abbreviations should be explained in a footnote. Footnotes should be designated by symbols in the following order: *,†, ‡, §, ¶.

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Editorial Correspondence

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Original Article / Orijinal Araştırma

Change in Medical Sharps Injury Characteristics During the COVID-19 Pandemic

Tıbbi Kesici Delici Alet Yaralanma Karakteristiklerinin COVID-19 Pandemisi Sürecindeki Değişimi

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Abstract

Aim: Knowledge about the change in the frequency and characteristics of medical sharps injuries during the Coronavirus Disease–2019 (COVID-19) pandemic is very limited. This study aimed to compare the characteristics of medical sharps injuries experienced by healthcare staff before and during the COVID-19 pandemic.

Material and Method: A total of 304 cases of medical sharps injuries suffered by hospital staff in our hospital between 2014 and 2022 were included in the study. Data regarding these accidents were obtained from workplace accident files in the hospital archive.

Results: The mean age of the staff exposed to the accident was 30.2±10.7 (age range: 15-50) years, and 227 (74.7%) were women. During the pandemic, a 34.6% decrease was detected in the annual mean number of medical sharps injuries compared to before the pandemic. In cases during the pandemic, the annual mean rate of interns who had an accident decreased significantly compared to before the pandemic (43.7% vs. 18.8%) in comparison the mean rate of nurses increased significantly (31.9% vs. 53.2%)(p<0.001), and the annual mean needle tip rate decreased significantly (83.0% vs. 68.0%)(p=0.035).

Conclusion: The findings of the present study showed that there was a significant decrease in the number of medical sharps accidents during the pandemic compared to the pre-pandemic period, that the rate of nurses who were exposed to accidents increased significantly during this period, that there was a significant decrease in the rate of needle stick-related accidents, that there was a significant decrease in the accident rate in surgical wards and a significant increase in intensive care units.

Keywords: Medical sharps injury, needle stick, COVID-19, pandemic

Öz

Amaç: Tıbbi kesici-delici alet yaralanmaları sıklığının ve karakteristik özelliklerinin Coronavirus Disease–2019 (COVID-19) pandemisi sürecindeki değişimi ile ilgili bilgiler çok kısıtlıdır. Bu çalışmada sağlık personelinin yaşadığı tıbbi kesici-delici alet yaralanma kazalarının COVID-19 pandemisi öncesindeki ve pandemi sürecindeki karakteristiklerinin karşılaştırılması amaçlanmıştır.

Gereç ve Yöntem: Çalışmaya 2014-2022 yılları arasında hastanemizde hastane personelinin maruz kaldığı toplam 304 tıbbi kesici-delici alet yaralanma olgusu dahil edildi. Bu iş kazalarına ait veriler hastane arşivindeki iş kazası dosyalarından elde edildi.

Bulgular: Kazaya maruz kalan personelin ortalama yaşı 30,2±10,7 (yaş aralığı: 15-50) idi, 227'si (%74,7) kadındı. Pandemi sürecinde pandemi öncesine göre yıllık ortalama tıbbi kesici-delici alet yaralanma sayısında %34,6'lık düşüş saptandı. Pandemi sırasındaki olgularda kazaya uğrayan yıllık ortalama stajyer oranının pandemi öncesine göre anlamlı düştüğü (%43,7 vs. %18,8), ortalama hemşire oranının anlamlı arttığı (%31,9 vs. %53,2) (p<0,001) ve yıllık ortalama iğne ucu oranının anlamlı düştüğü (%83,0 vs. %68,0)(p=0,035) saptandı.

Sonuç: Çalışmamızdan elde edilen bulgular pandemi sürecinde pandemi öncesine göre tıbbi kesici delici alet yaralanmaları sayılarında belirgin düşüş olduğunu, bu süreçte kazaya maruz kalanlarda hemşire oranının belirgin arttığını, iğne ucuna bağlı kaza oranında belirgin düşüş olduğunu, cerrahi servislerdeki kaza oranında büyük düşüş ve yoğun bakım ünitelerindeki kaza oranlarında büyük artış olduğunu göstermiştir.

Anahtar Kelimeler: Tıbbi kesici delici alet yaralanması, iğne ucu, COVID-19, pandemi

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INTRODUCTION

Medical sharps injuries are critical accidents that carry a high risk of transmitting chronic severe viral diseases transmitted through the blood of the patient to whom the material is applied to the healthcare worker. It has been stated that these accidents mostly occur in the form of needle sticking to the patient during or after the application and that trying to attach the syringe caps in a significant number of them increases the risk of accidents.[1-3] The main reason for the risk of infection is that the material causes an accident after coming into contact with the patient blood. Various precautions are taken in medical centers in this regard. Despite this, there is no decrease in the frequency of these accidents in many centers. Even in the reporting of such accidents, there are some deficiencies and there may be a risk of some health and legal problems.[1-4]

During the Coronavirus Disease–2019 (COVID-19) pandemic, routine patient admissions have been restricted and non-urgent operations have been postponed all over the world. In addition, serious safety precautions have been taken and strict procedures have been implemented in approaching patients in health centers. During this period, there was a significant decrease in invasive procedures, except for COVID-19 patients.[5-7]

Information regarding the change in the frequency and characteristics of medical sharps injuries during the COVID-19 pandemic is very limited. This study aimed to compare the characteristics of medical sharps injuries experienced by healthcare staff before and during the COVID-19 pandemic.

MATERIAL AND METHOD

Cases and Data

This retrospective study was approved by the local ethics committee. A total of 304 cases of medical sharps injuries suffered by hospital staff in our hospital between 2014 and 2022 were included in the study. Data regarding these accidents were obtained from accident files in the hospital archive. From the accident reports, the identity of the staff involved in the accident, their duties and the unit they worked in, the medical equipment that caused the accident, and the health status of the patient for whom the medical equipment that caused the accident was used were recorded.

All accidents in the mentioned period were included in the study, but injuries involving non-healthcare workers were not included.

Statistical Analysis

The sample size in the study was calculated by power analysis using G-Power (version 3.1.9.6, Franz Faul, Universitat Kiel, Germany). Effect size 0.3; Type 1 error was taken as 0.05 and test power as 0.95, and the sample size was calculated as 220.

All statistical analyzes in the study were performed using SPSS 25.0 software (IBM SPSS, Chicago, IL, USA). Descriptive data were given as numbers and percentages. Comparisons between groups in terms of categorical variables were made with Pearson's Chi Square test. The results were evaluated within the 95% confidence interval and p values <0.05 were considered significant. Bonferroni correction was made where necessary.

This study was approved by the instituonal ethics committee (no: SÜKAEK 2023- 15/7) and complied with the Declaration of Helsinki and good clinical practice guidelines.

RESULTS

The mean age of the staff exposed to the accident was 30.2±10.7 (age range: 15-50) years, and 227 (74.7%) were women. A total of 113 (37.2%) of the staff were nurses, 114 (37.5%) were nursing intern students, and 43 (14.1%) were cleaning staff. Of the medical supplies that caused the accident, 241 (79.3%) were needle tips and 40 (13.2%) were lancets. In 282 (92.8%) of the cases, information on the patient's health status for whom the material that caused the accident was used could not be obtained. Of the patients whose health information was available, six (2%) were HBsAg positive, nine (3.0%) were AntiHCV positive, and two (0.7%) were positive for AntiHIV (**Table**).

While a total of 229 injuries occurred in the 5-year period covering 2014-2019 before the pandemic, a total of 75 injuries were observed in the 3-year pandemic period covering 2020-2022. The annual mean number of medical sharps injuries decreased from 38.2 to 25 during the pandemic compared to before the pandemic (34.6% decrease). In cases during the pandemic, the annual mean rates of interns (43.7% vs. 18.8%) and cleaning staff (16.2% vs. 8.0%) who had accidents decreased significantly compared to before the pandemic, and the mean number of nurses injured. It was found that the rate increased significantly (31.9% vs. 53.2%) ($p<0.001$) It was determined that the annual average intern (%43,7 vs. %18,8) and cleaning staff injuries (%16,2 vs. %8,0) during the pandemic decreased significantly compared to before the pandemic, while the average nurse injury rate increased significantly (%31,9 vs. %53,2) ($p<0,001$) (**Table**).

In terms of medical materials causing accidents in cases during the pandemic, it was determined that the annual mean needle tip rate decreased significantly compared to before the pandemic (83.0% vs. 68.0%), while the lancet rate increased significantly (11.0% vs. 20.0%) ($p=0.035$) (**Table**).

In cases during the pandemic, it was determined that the annual mean surgical service rate in terms of units where the accident occurred decreased significantly compared to before the pandemic (16.5% vs. 6.8%), and the rate of intensive care units increased significantly (7.1% vs. 32.0%) (**Table**).

The cases during the pandemic and before the pandemic were found to be similar in terms of the gender distribution of the annual mean healthcare staff involved in the accident and the distribution of the health status of the patients in whom the medical equipment was used ($p>0.05$ for both) (**Table**).

Table. Distribution and comparisons of the characteristics of medical sharps accidents before and during the pandemic.

	Total		Total (2014-2019)		Total (2020-2022)		The mean annual injuries (2014-2019)		The mean annual injuries (2020-2022)		p
	n	%	n	%	n	%	n	%	n	%	
Total	304		229		75		38.2		25		
Gender											0.359
Female	227	74.7	168	73.4	59	78.7	28	73.3	19.7	78.8	
Male	77	25.3	61	26.6	16	21.3	10.2	26.7	5.3	21.2	
Job											<0.001
Nurse	113	37.2	73	31.9	40	53.3	12.2	31.9	13.3	53.2	
Intern	114	37.5	100	43.7	14	18.7	16.7	43.7	4.7	18.8	
Cleaning staff	43	14.1	37	16.2	6	8	6.2	16.2	2	8	
Other	34	11.2	19	8.3	15	20	3.2	8.4	5	20	
Tool											0.035
Needle tip	241	79.3	190	83	51	68	31.7	83	17	68	
Lancet	40	13.2	25	10.9	15	20	4.2	11	5	20	
Other	23	7.5	14	6.1	9	12	2.2	5.8	3	12	
Source											0.340
Unknown	282	92.8	215	93.9	68	90.7	35.8	93.7	22.7	90.8	
Known	21	6.9	14	6.1	7	9.3	2,3	6	2,3	9.2	
Healthy	4	1.3	3	1.3	1	1.3	0.5	1.3	0.3	1,2	
HBsAg	6	2	4	1.7	2	2.7	0.7	1.8	0.7	2.8	
Anti HCV	9	3	6	2.6	3	4	1	2.6	1	4	
Anti HIV	2	0.7	1	0.4	1	1.3	0.2	0.5	0.3	1,2	
Units											<0.001
Emergency room	69	22.7	52	22.7	17	22.7	8.7	22.8	5.7	22.8	
Operating room	27	8.9	21	9.2	6	8	3.5	9.2	2	8	
Surgical services	43	14.1	38	16.6	5	6.7	6.3	16.5	1.7	6.8	
Internal services	64	21.1	46	20.1	18	24	7.7	20.2	6	24	
ICU	40	13.2	16	7	24	32	2.7	7.1	8	32	
Blood collection unit	10	3.3	10	4.4	0	0	1.7	4.5	0	0	
Waste depots	8	2.6	8	3.5	0	0	1.3	3,4	0	0	
Laundry	6	2	6	2.6	0	0	1	2.6	0	0	
Other units	37	12.2	32	14	5	6.7	5.3	13.9	1.7	6.8	

ICU: Intensive care unit

In the control examinations of the healthcare staff exposed to the accident within weeks after the accident, it was seen that there was no contamination in hepatitis B, hepatitis C and HIV screenings.

DISCUSSION

Medical sharps injuries cause significant health risks for healthcare workers. Various precautions are taken to prevent these accidents.[2,4] During the COVID-19 pandemic, there have been serious restrictions on routine patient admission and routine procedures. During the pandemic, many additional precautions were taken regarding approach to patients and various new procedures began to be implemented.[6,7] The present study revealed that these changes during the pandemic caused a decrease in the number of medical sharps injuries.

During the pandemic, restrictions were imposed on routine patient admission and many routine invasive procedures in health centers, and many procedures were postponed or cancelled. There has been a significant decrease in the total number of invasive procedures in hospitals.[5-7] Stojic et al.[8] reported in their study that the monthly mean number of medical sharps accidents before and during the pandemic did not change significantly. In the present study, it was determined that the annual mean number of medical sharps injuries decreased from 38.2 to 25, and this decrease was 35.6%. This may be due to the fact that routine patient admission and routine operations were significantly restricted during the pandemic period. In addition, the measures taken within the scope of COVID-19 measures due to the pandemic may have also contributed to the decrease in this number. The present study detected no chronic viral disease positivity in the staff who had these accidents. Stojic et al.[8] reported that the hepatitis B, hepatitis C and HIV positivity rates did not change in those who had a medical sharps accident during the pandemic period. This shows that the pandemic process does not significantly affect the risk of viral disease transmission after such an accident.

It has been reported that nurses and healthcare staff in direct contact with patients are most frequently exposed to medical sharps injuries.[1,2] During the pandemic, there was an increase in the workload of health professionals, and many changes were made in the work distribution in health centers.[5,6] Some studies have reported that nurses and intern students are most frequently exposed to medical sharps injuries.[9-13] Diktas et al.[14] found in their study that those who were exposed to medical sharps injuries at the highest rate in the year before the pandemic were nurses and intern students, respectively, and that there was no significant change in the rate of nurses with the start of the pandemic, but no intern student accidents were observed. In the present study, it was determined that 37.2% of the staff involved in the accident were nurses, 37.5% were nursing intern students, and 14.1% were cleaning staff. This finding shows that most medical sharps injuries occur during or immediately after application to the patient, and a small number occur during the collection of materials. In the present study, we also found that the annual mean rate of interns (43.7% vs. 18.8%) and cleaning staff (16.2% vs. 8.0%) who had accidents during the pandemic decreased significantly compared to before the pandemic, and the mean rate of nurses (31.9% vs. 53.2%) was found to increase significantly. These findings may have resulted from restrictions on the acceptance, employment and scope of work of intern students during the pandemic.

It has been stated that needle tips are the most common cause of medical sharps injuries.[1-4] Major changes have been made in many practices during the pandemic process, and many strict procedures have begun to be implemented regarding contact with patients. These applications; It has also caused differences in some processes such as the use, collection and disposal of materials.[7,15] Some studies have reported that the majority of medical sharps accidents occur due to needle stick.[16-18] Diktas et al.[14] reported in their study that the needle stick rate, which was 81% the year before the pandemic, increased to 91% in the year the pandemic started. Stojic et al.[8] found in their study that the needle stick accident rate increased from 89.2% to 93.3% and that the change was not statistically significant. In the present study, it was determined that 79.3% of the medical materials that caused the accident were needle tips and 13.2% were lancets. This finding shows that, as expected, the needle tip most frequently causes medical sharps injuries. In the present study, it was also found that the annual mean needle tip rate in terms of medical materials causing accidents in cases during the pandemic decreased significantly compared to before the pandemic (83.0% vs 68.0%), while the lancet rate increased significantly (11.0% vs 20.0%). This may be due to the significant decrease in injection procedures as a result of the restrictions on routine patient admission during the pandemic period and the resulting change in the patient portfolio.

It has been stated that medical sharps injuries occur most frequently in units where procedures such as injection and blood collection are performed intensively.[18,19] Restrictions and changes in patient admission and some procedures during the pandemic period have led to differences in these procedure intensities.[18-20] Some studies have reported that medical sharps accidents occur most frequently in wards, emergency rooms or intensive care units.[18-21] Diktas et al.[14] stated in their study that there was a two-thirds decrease in the total annual number of operations in the year the pandemic started. In the present study, it was determined that the annual mean surgical service rate in terms of the units where the accident occurred in the cases during the pandemic decreased significantly compared to the pre-pandemic (16.5% vs. 6.8%), and the rate of intensive care units increased significantly (7.1%). etc. 32.0%). These findings can be attributed to the decrease in the number of operations due to the restriction of routine operations during the pandemic period, therefore the decrease in the number of patients in surgical wards and the significant increase in the number of patients in intensive care units due to COVID-19.

Reporting accidents in medical sharps injuries is of great importance.[1,3] Despite the strict security measures in applications during the pandemic period, there may have been disruptions in some reporting issues due to the focus on COVID-19.[14] In the present study, hepatitis B, hepatitis C or HIV positivity was detected in the patient in whom the material was used in 5.7% of the cases, and in 92.8% of the cases, information on the health status of the patient in whom the material was used that caused the accident could not be obtained. In addition, the cases during and before the pandemic were found to be similar in terms of the distribution of health status of the patients for whom medical equipment was used. These findings show that there is probably a significant deficiency in accident reporting procedures for medical sharps injuries by both the injured staff and the relevant units, and this deficiency could not be eliminated during the pandemic period. This situation indicates that in such cases, where healthcare workers are at significant risk of serious viral infections, not knowing and/or not recording the health information of the patient to whom the material is applied risks both the health of the staff and the subsequent legal processes.

Some of the limitations of the present study are that a comparison regarding this process could not be included in the study due to the fact that a long period of time has not passed after the pandemic, and that a real risk analysis could not be made since the health information of the patients to whom the medical equipment was applied was not included in most of the reports. The positive aspect of the present study is that the duration of the study was longer at nine years and better comparisons were made with a higher number of cases.

CONCLUSION

The findings obtained from the present study showed that there was a significant decrease in the number of medical sharps accidents during the pandemic period compared to the pre-pandemic period, the rate of nurses among those exposed to accidents increased significantly during this period, a significant decrease in the rate of needle stick-related accidents, a significant decrease in the accident rate in surgical wards and a significant increase in the accident rates in intensive care units.

ETHICAL DECLARATIONS

Ethics Committee Approval: This study was approved by the ethics committee of Samsun Training and Research Hospital (no: SÜKAEK 2023- 15/7).

Informed Consent: All patients signed the free and informed consent form.

Referee Evaluation Process: Externally peer-reviewed.

Conflict of Interest Statement: The authors have no conflicts of interest to declare.

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Author Contributions: All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

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Original Article / Orijinal Araştırma

An Investigation on the Effect of Smartphone Use on Morphological and Radiological Changes of the Fifth Finger

Akıllı Telefon Kullanımının Beşinci Parmağın Morfolojik ve Radyolojik Değişikliklerine Etkisinin İncelenmesi

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Abstract

Aim: The purpose of this study is to describe the macroscopic and radiological changes on the fifth finger related to mobile phone use and to evaluate the effect of size and weight of the device and the average time spent using the smartphone on these morphological changes.

Material and Method: A total of one hundred and one patients were enrolled in the study. Data including age, weight, height, education level, mobile phone usage, and digital photographs were collected through interviews conducted with participants in an outpatient orthopedics clinic. Digital images of the dorsal aspects of both hands were captured using an iPhone X® equipped with a dual 12-megapixel wide camera. The angle of the distal interphalangeal (DIP) joint of the fifth finger was measured using computer software (Image J® version 1.46, National Institute of Health, Bethesda, MD) from both digital photographs and anteroposterior (AP) hand X-rays separately.

Results: The proportion of smartphone usage time exceeding 4 hours was significantly higher among patients with complaints compared to those without complaints ($p < 0.05$). Similarly, the mean duration of smartphone usage exceeding 4 hours was significantly greater in patients with shape discrepancy than in those without shape discrepancy ($p < 0.05$).

Conclusion: Taking into account all the data from our study, it is evident that even in cases where no radiological findings are detected in individuals who use their phones for more than 4 hours daily, shape deformities in soft tissue may still result in clinical discomfort for the patient.

Keywords: Smartphone, radiological, morphological, pinky, fifth finger, mobile phone

Öz

Amaç: Bu çalışmanın amacı, cep telefonu kullanımına bağlı olarak beşinci parmakta meydana gelen makroskobik ve radyolojik değişiklikleri tanımlamak ve cihazın boyutu, ağırlığı ile akıllı telefonda geçirilen ortalama sürenin bu morfolojik değişikliklere etkisini değerlendirmektir.

Gereç ve Yötem: Çalışmaya 101 hasta dahil edildi. Bu kesitsel çalışmada kullanılan yaş, kilo, boy, eğitim, cep telefonu verileri ve dijital fotoğraflar, bir ortopedi kliniği ortamında katılımcılarla yapılan görüşmelerden elde edilmiştir. Her iki elin sırt kısmının dijital fotoğrafları bir iPhone X ® (çift 12 megapiksel geniş kamera) ile çekildi. Beşinci parmağın DIP eklem açısı bilgisayar yazılımında (Image J® versiyon 1.46, Ulusal Sağlık Enstitüsü, Bethesda, MD) dijital fotoğraflar ve AP el röntgenleri için ayrı ayrı ölçüldü.

Bulgular: Şikayeti olan hastalarda 4 saatten fazla akıllı telefon kullanım süresi şikayeti olmayan hastalara göre anlamlı olarak daha yüksekti ($p<0,05$). Şekil farklılığı olan hastalarda ortalama 4 saatten fazla akıllı telefon kullanma süresi, şekil farklılığı olmayan hastalara göre anlamlı olarak daha yüksekti ($p<0,05$).

Sonuç: Çalışmamızın tüm verileri göz önüne alındığında günlük 4 saatten fazla telefon kullananlarda radoyolojik bulgular saptanmasa bile yumuşak dokuda görülen şekil bozukluğu sonucu hastada klinik rahatsızlıklar görülebilmektedir.

Anahtar Kelimeler: Akıllı telefon, radyolojik, morfolojik, serçe parmak, beşinci parmak, cep telefonu

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INTRODUCTION

The global proliferation of smartphones has experienced a rapid escalation, mirroring the evolution of these devices from simple cell phones to portable computers. Currently, the worldwide tally of smartphone users has soared to 6.92 billion, comprising 86.41% of the global population as smartphone owners. Smartphones provide a diverse array of features through software applications, spanning entertainment, email, online messaging, and social media.

Turkey, boasting a relatively young population, foresees a surge in smartphone users, expected to reach 84.07 million by the year 2029. Despite the convenience these devices bring to work and daily life, there is a growing concern about the adverse effects of excessive smartphone usage on mental and physical health. Various studies have delved into the connection between smartphone usage and musculoskeletal problems.

Injuries related to overuse of the hand and wrist, including tendinitis, trigger finger, and nerve entrapment syndromes, have been associated with smartphone use.[5-10] In addition to symptoms such as pain and paresthesia, smartphones are now being accused of causing morphological alterations, particularly in the upper extremities. Various methods of holding a smartphone exist, with one common technique involving grasping the device with one hand and utilizing the radial surface of the DIP joint of the fifth finger as a support under the device.[11] Recently, smartphone users have started claiming that the shape of their fifth finger has altered due to excessive smartphone use, sharing images of their so-called "smartphone pinkies" on social media. Despite the prevalence of this topic on social platforms, limited evidence exists regarding smartphone-related alterations to bones and soft tissues. While macroscopic morphological changes in the fifth finger due to smartphone use have been demonstrated, attention has not been given to the radiological bone and joint structure of the hands.[11]

This study aims to investigate both the morphological and radiological changes in the fifth finger caused by smartphone use. The objective is to describe the macroscopic and radiological alterations in the fifth finger related to mobile phone use and assess the impact of device size and weight, as well as the average time spent using the smartphone, on these morphological changes.

MATERIAL AND METHOD

After obtaining approval from the local ethics committee (2019/11-17), the institutional radiological database was searched for hand AP x-rays taken within the last two months. A retrospective database search revealed 158 hand x-rays. Patients with congenital or acquired deformities, hand or wrist fractures, and those under the age of 18 were excluded from the study. Out of the remaining 109 patients, 101 agreed to participate. Data including age, weight, height, education, mobile phone usage, and digital photographs were obtained through interviews with participants in an outpatient orthopedic clinic setting for this cross-sectional study.

The authors provided detailed information by directly explaining the survey to the participants. In addition to assessing their smartphone attitudes, patients were also asked about the brand and model of their mobile devices. Data regarding device size and weight were sourced from each manufacturer's official website.

Data on the daily time spent using mobile phones were also collected from existing smartphone "screen time" applications. Regarding complaints related to the assessment of the fifth finger, participants were asked to indicate whether they experienced pain, numbness, or any discomfort in their dominant hand, specifically in the fifth finger. Participants were instructed to place their hands in a neutral position on the table without applying pressure. A scale (ruler) was placed next to each hand, and digital photographs of the dorsum of both hands were captured using an iPhone X® (dual 12-megapixel wide camera). The DIP (Distal Interphalangeal) joint angle of the fifth finger was measured separately for digital photographs and AP (Anteroposterior) hand x-rays using computer software (Image J® version 1.46, National Institutes of Health, Bethesda, MD). To determine the DIP joint angle from digital photographs, examiners selected four points: two visual separation points for the head and base of the fifth distal phalanx, and two visual separation points for the head and base of the fifth intermediate phalanx (**Figure 1A**). Two lines were carefully drawn between each pair of points, and the software utilized these lines to calculate the DIP joint angle, which represents the angle formed by the intersection of the longitudinal axis of the fifth distal and middle phalanges. Radiological measurements were conducted by a musculoskeletal specialist radiologist following direct radiographs taken in full anteroposterior view. The angle between the line drawn from the proximal and distal midpoint of the fifth distal phalanx and the line passing through the distal and proximal of the 5th finger midphalanx was determined (**Figure 1B**).

The study recorded the age, gender, and education status of the patients, as well as the weight and screen width of the phones they used, their daily phone usage (in hours), and angle measurements calculated from separate photographs and direct radiography. The results were categorized demographically, and the reported effects were analyzed based on whether the patients had finger deformities and whether they spent more or less than 4 minutes on the phone per day. Given that the global average for smartphone usage is 3 hours and 45 minutes, while the Turkish average is 4 hours and 16 minutes, an average of 4 hours was utilized as a reference in the analysis.

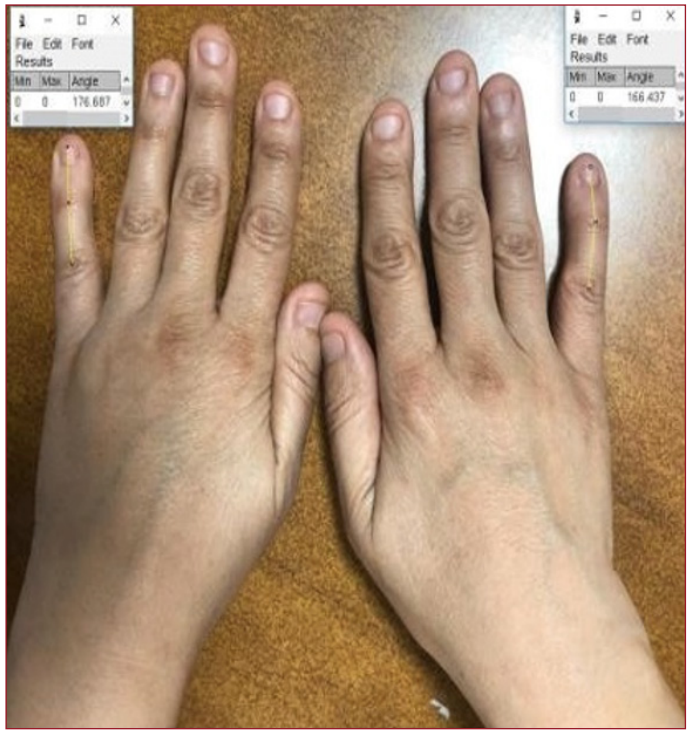

Figure 1a: The picture shows the measurement technique of the angulation of fifth finger by using the photo (a).

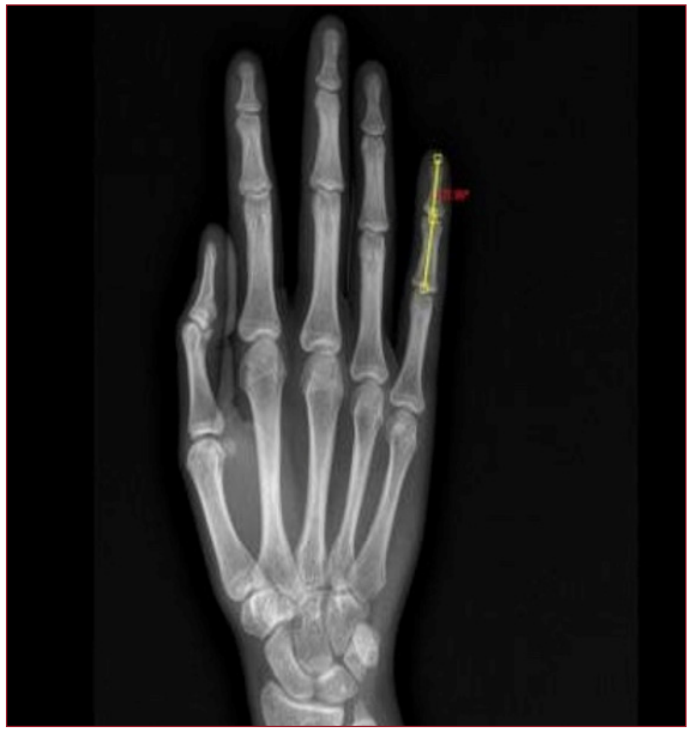

Figure 1b: The picture shows the measurement technique of the angulation of fifth finger by using the X-ray (b).

Statistical Analysis

Descriptive statistics, comprising mean, standard deviation, median, minimum and maximum values, frequency, and ratio values, were utilized to summarize the data. The distribution of variables was assessed using the Kolmogorov-Smirnov test. The analysis of quantitative independent data was performed using the Mann-Whitney U test, while the Chi-square test was employed for the analysis of qualitative independent data. Statistical analysis was carried out using the SPSS (Statistical Package for the Social Sciences, IBM, New York®, NY) version 26.0 program.

RESULTS

The average age of the patients was 28.7 years. The mean weight of smartphones carried by the patients was determined to be 161.5 grams, with an average screen size of 5.4 inches. Among the participants, 37 spent less than 4 hours on their smartphones, while 64 spent more than 4 hours daily. The distribution of radiography photographs was 4.2, and the distribution was measured as 7.0. Regarding complaints about the fifth finger, 25 participants (24.8%) reported having such complaints, and 9 patients showed a noticeable change in the shape of their finger (**Table 1**).

Tablo 1. Demographic characteristics of the patients

	Complaint (-)		Complaint (+)		p
	Mean±s.s./n-%	Median	Mean±s.s./n-%	Median	
Age	28.4±7.1	27.5	29.5±8.3	30.0	
Gender					
Female	21	27.6%	10	40.0%	0.452 m
Male	55	72.4%	15	60.0%	0.245 x2
Height	173.0±7.0	174.0	172.6±8.1	173.0	0.668 m
Weight	76.7±12.0	76.5	70.8±22.0	70.0	0.046 m
BMI* (kg/m2)	25.6±3.3	25.3	23.7±6.6	23.1	0.038 m
Educational status					0.707 x2
Highschool	47	61.8%	14	56.0%	
College	11	14.5%	3	12.0%	
Faculty	18	23.7%	8	32.0%	
Smartphone Weight (gr)	161.1±20.2	167.0	162.6±21.3	163.0	0.679 n
Smartphone Display Size (Inch)	5.4±0.8	5.5	5.4±0.5	5.5	0.714 n
Daily smartphone usage time (per day)	3.8±1.5	4.0	5.8±2.9	6.0	0.000 n
Daily smartphone usage time					0.014 x2
< 4 hours	33	43.4%	4	16.0%	
≥ 4 hours	43	56.6%	21	84.0%	

m Mann-Whitney U test / x2 Chi-square test, BMI*: Body mass index

There was no significant difference between the groups with and without complaints in terms of diseases, age, gender problems, and height (p>0.05). However, the weight and BMI values of individuals with complaints were significantly lower than those without complaints (p<0.05). There was no significant difference between educational status, smartphone weight and size angle between the two groups (p>0.05). However, the group with complaints had a significantly higher daily smartphone usage time (p<0.05). Additionally, the number of patients with complaints who used their smartphone for more than 4 hours daily was significantly higher than those without complaints (p<0.05) (**Figure 2a**) (**Table 2**). Patients with shape differences in their fifth fingers were found to be older than those without shape differences, and this difference was statistically significant (p<0.05). However, there was no difference between these two groups in terms of gender, male, weight, and BMI (p>0.05). Additionally, there was no difference between the groups with and without shape differences regarding the duration of education and the weight and size of the smartphone (p>0.05). In contrast, the average smartphone usage time of more than 4 hours in the patient group with shape differences was significantly higher than in the patient group without shape differences (**Figure 2b**) (p<0.05). Furthermore, there was no significant difference between patients with and without shape differences in terms of the degree of DIP angulation on the radiograph or the angle of DIP angulation in the photograph (p>0.05) (**Table 2**). There was no significant difference in terms of education level, smartphone weight, or smartphone size in patients with smartphone usage time <4 hours and ≥4 hours (p>0.05). Additionally, using 4 or more smartphones did not show a significant difference in terms of the angulation angle seen in radiography and photography (p>0.05) (**Table 3**).

DISCUSSION

The most significant finding of this study was the association between daily smartphone usage time and the discrepancy in the shape of the fifth finger. Our results suggest that using a smartphone for over 4 hours per day increases the risk of a shape discrepancy in the fifth finger, resulting in asymmetry. However, no observable changes were detected on radiography.

The global surge in smartphone usage has been remarkable, prompting numerous published articles investigating musculoskeletal disorders linked to smartphone use.[5-8] The existing literature, in particular, has focused on injuries affecting the upper extremities. In a comprehensive review, Etivipart et al. identified the most affected body regions as the head-neck, shoulder-arm, and hand-thumb.[12] They also established a correlation between musculoskeletal symptoms around the hand-thumb and one-handed smartphone use. Several authors have categorized the relationship between symptoms and the use of smart devices into various syndromes, such as "overuse injury," "repetitive strain injury," "nintendinitis," "Blackberry thumb," and "Whatsappitis.".[9,13-16] However, many of these authors did not extensively investigate morphological changes in the hand. Fuentes-Ramirez et al. conducted a study to assess the role of the fifth finger in manipulating smartphones and investigated whether asymmetry was being induced in the fifth finger.[11] They specifically evaluated photographs of fifth fingers but were limited to assessing soft tissue changes. In our study, we extended the analysis by incorporating X-rays to examine both bony structures and soft tissue. Interestingly, our results did not reveal any bony changes, contrary to the observed soft tissue asymmetry. In a separate experimental study, Gustafsson et al. identified differences in typing style among young adult patients with and without musculoskeletal symptoms.[17] However, Fuentes-Ramirez et al. did not report any statistical significance between holding techniques and the area of asymmetry.[11]

Tablo 2. Evaluation of parameters according to whether patients had finger related complaints.

	Shape discrepancy of finger (-)		Shape discrepancy of finger (+)		p
	Mean±s.s./n-%	Median	Mean±s.s./n-%	Median	
Age	28.1±7.2	27.5	34.3±7.2	38.0	0.013 m
Gender					
Female	27	29.3%	4	44.4%	0.349 x2
Male	65	70.7%	5	55.6%	
Height	173.0±7.1	174.0	168.8±7.9	170.0	0.122 m
Weight	75.4±15.2	76.0	74.2±15.9	70.0	0.445 m
BMI* (kg/m2)	25.0±4.4	24.9	26.0±5.0	26.8	0.655 m
Educational status					
Highschool	55	59.8%	6	66.7%	
College	12	13.0%	2	22.2%	0.338 x2
Faculty	25	27.2%	1	11.1%	
Smartphone Weight (gr)	161.2±20.7	167.0	164.7±17.8	167.0	0.962 m
Smartphone Display Size (Inch)	5.4±0.7	5.5	5.5±5.5	5.5	0.538 m
Daily smartphone usage time (per day)	4.1±2.0	4.0	6.1±2.6	6.0	0.007 m
Daily smartphone usage time					
< 4 hours	37	40.2%	0	0%	0.017 x2
≥ 4 hours	55	59.8%	9	100%	
DIP- Radiography (Degree of angulation)	4.2±3.5	3.7	3.3±1.7	2.7	0.659 m
DIP- Photo (Degree of angulation)	7.3±3.6	6.4	6.6±2.3	5.5	0.866 m

m Mann-Whitney U test / x2 Chi-square test, BMI*: Body mass index

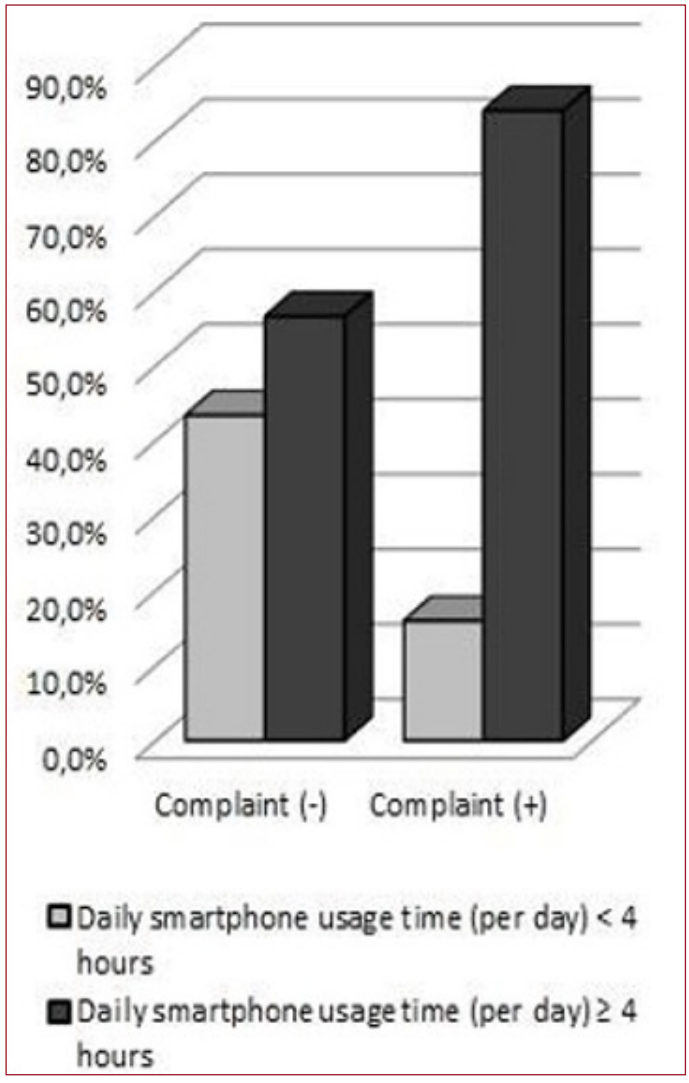

Figure 2a: The graph comparing daily smartphone usage time of patients with and without complaints related fifth finger.

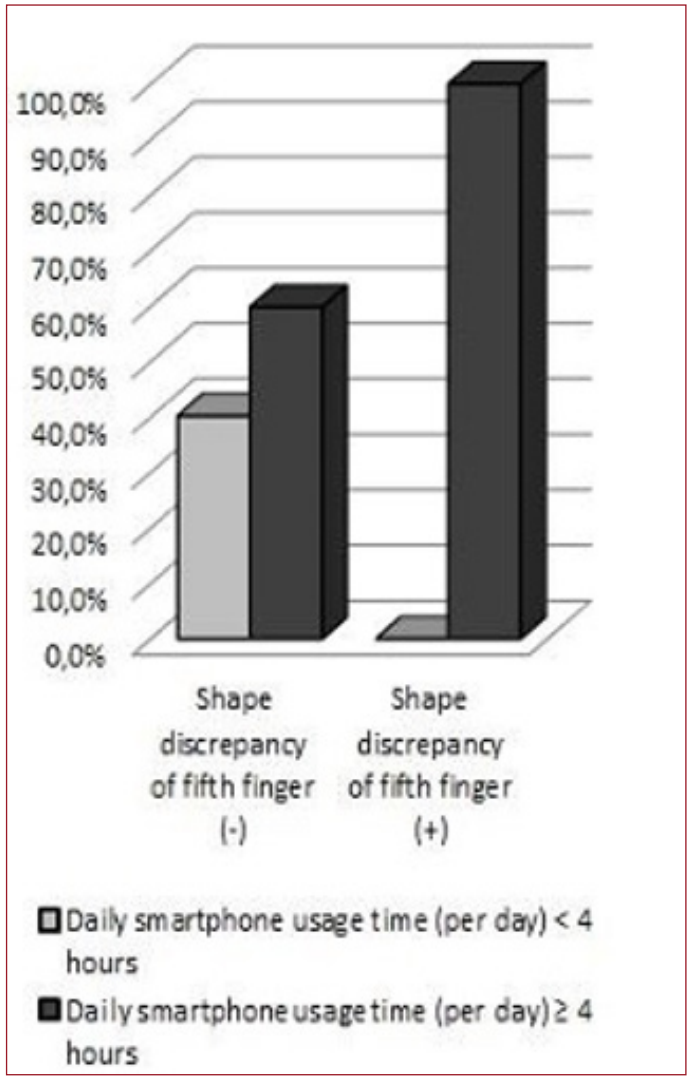

Figure 2b: The graph comparing daily smartphone usage time of patients with and without shape discrepancy of little finger.

Tablo 3: Relationship between parameters and daily smartphone usage time.

	Daily smartphone usage time (per day) < 4 hours		Daily smartphone usage time (per day) ≥ 4 hours		p
	Mean±s.s./n-%	Median	Mean±s.s./n-%	Median	
Age	29,6±7,1	32,0	28,1±7,5	27,0	0,366 m
Gender					
Female	9,0	24,3%	22,0	34,4%	0,291 x2
Male	28,0	75,7%	42,0	65,6%	
Height	174,5±6,8	174,0	172,0±7,4	172,5	0,101 m
Weight	76,6±16,3	78,0	74,5±14,5	75,0	0,178 m
BMI* (kg/m2)	25,1±4,8	25,4	25,1±4,2	24,9	0,485 m
Educational Status					
Highschool	27,0	73,0%	34,0	53,1%	
College	5,0	13,5%	9,0	14,1%	0,085 x2
Faculty	5,0	13,5%	21,0	32,8%	
Smartphone Weight (gr)	161,3±19,3	167,0	161,6±21,2	167,0	0,930 m
Smartphone Display Size (Inch)	5,4±0,9	5,5	5,4±0,6	5,5	0,465 m
DIP- Radiography (Degree of angulation)	4,2±3,9	3,6	4,2±3,2	3,7	0,472 m
DIP- Photo (Degree of angulation)	4,3±1,7	4,3	7,3±3,1	6,5	0,207 m

m Mann-Whitney U test / x2 Chi-square test, BMI*: Body mass index

One holding technique, where the smartphone is supported by the medial border of the fifth finger, might contribute to the observed discrepancy. In our study, we did not investigate holding techniques, and participants were not asked about their preferred holding technique, representing a limitation of our research. Contrary to Fuentes-Ramirez et al., who found no significant differences between the asymmetry of the fifth finger and daily usage time or years of ownership,[11] our study revealed a significant association between daily smartphone usage time and the shape discrepancy of the fifth finger.

In a recent study conducted by Toh et al., the association between mobile touch screen devices (smartphones, tablets) and musculoskeletal symptoms and visual health was investigated in participants under 18 years old.[18] The authors reported that increased smartphone or tablet usage duration did not predict a higher risk of experiencing musculoskeletal symptoms, contrary to some previously published articles.[19-21]

In our study, participants with a shape difference in their fifth finger had significantly longer daily smartphone usage time than those without. A difference in shape was observed in 9 out of 64 participants who used a smartphone for more than 4 hours a day. Unlike other studies, our sample consisted of participants over the age of 18.

Amjad et al. investigated the frequency of wrist pain among students who use mobile phones.[22] They concluded that the duration of phone usage had a significant association, while screen size did not. Similarly, in our study, we found significance in smartphone usage time exceeding 4 hours. No significant difference was found between smartphone size and weight and the discrepancy of the fifth finger.

A study conducted by Berolo et al. reported musculoskeletal symptoms in the thumb among a university population who spent over 3.5 hours/day on their smartphones.[9] The study primarily focused on university students, including some staff and faculty members. Participants were asked about the duration of time spent on their phones on a typical day.

In addition to daily usage time, the participants in our study were not asked about the number of years they had been using their smartphones. Although we included participants who had used a smartphone for at least one year, we did not conduct a statistical evaluation based on the total number of years the phone had been used, representing another limitation of our study. Nevertheless, the observation that the average age was higher in participants with shape discrepancies suggested that individuals who use smartphones for a longer duration might be at a higher risk, albeit indirectly.

Furthermore, we investigated whether educational status affects the shape discrepancy of the fifth finger. Although the average daily phone use was higher among high school graduates, this difference was not statistically significant.

Limitations of the Study

The sample size was small. We did not investigate the holding technique, and we also did not conduct a statistical evaluation based on the total number of years the phone had been used. Additionally, participants were not asked which holding technique they used most frequently, which is another limitation of our study.

CONCLUSION

Taking into consideration all the data from our study, it can be observed that, even if no radiological findings are detected in individuals who use their phones for more than 4 hours daily, shape deformities in soft tissue may lead to pain and visual discomfort in the patient. New studies correlating muscle strength, grip force measurements, and various imaging techniques will guide us in this regard..

ETHICAL DECLARATIONS

Ethics Committee Approval: This study was approved by the Kutahya Health Sciences University Faculty of Medicine Non-interventional Clinical Researches Ethics Committee (Decision No: 2019/11-17, Date: 05.11.2019)

Informed Consent: All patients signed the free and informed consent form.

Referee Evaluation Process: Externally peer-reviewed.

Conflict of Interest Statement: The authors have no conflicts of interest to declare.

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Author Contributions: All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

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Original Article / Orijinal Araştırma

Correlation of Capillary Tube and Transcutaneous Methods with Serum Biochemistry for Bilirubin Levels in Neonates with Indirect Hyperbilirubinemia

İndirekt Hiperbilirubinemili Yenidoğanlarda Bilirubin Düzeyleri için Kapiller Tüp ve Transkütan Yöntemlerinin Serum Biyokimyası ile Korelasyonu

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Abstract

Aim: This study aimed to compare transcutaneous bilirubin (TcB) measurement, which is a noninvasive, simple, fast, and inexpensive method for treating patients with indirect hyperbilirubinemia (IHB), to total serum bilirubin (TSB) measurement values, which are the standard method. In addition, the study included contemporaneous capillary tube (CT) bilirubin values to determine the relationship. We aimed to investigate the relationship between TSB and TcB levels before and after treatment for IHB in patients.

Material and Method: Between January 1 and July 1, 2023, newborns aged 37 to 42 weeks admitted to the neonatal intensive care unit at the Faculty of Medicine, Gaziosmanpasa University (Tokat, Turkey) with IHB were included. Patients who received phototherapy for IHB were evaluated retrospectively. TcB measurements were performed in patch-covered ears shortly before and 24 h after treatment (together with TSB and CT measurements). The data of patients who underwent phototherapy for IHB and had their TcB, TSB, and capillary tube bilirubin levels assessed before and after treatment were analyzed retrospectively. Measurements were taken at the beginning and 24 h of treatment.

Results: Seventy-two patients were term neonates. Six patients were excluded from the study because they did not meet the criteria. The mean gestational age was 37.23±0.60 weeks (37-40 weeks), and the mean weight was 2,751.52±432.84 g (2,100-4,550 g). Twenty-seven (40.9%) of the newborns were male. The direct Coombs test resulted in 1+ in five newborns and 4+ in one newborn. There was a statistically significant difference between TcB bilirubin levels and TSB measurement values before and after treatment. Furthermore, there was a statistically significant difference between the CT bilirubin and TSB measurement values before and after treatment.

Conclusion: Our study demonstrated a statistically significant difference in TSB bilirubin values using the TcB and CT methods before and after treatment. Although TcB and CT methods can be used in IHB screening, we do not recommend using them instead of the TSB measurement method for treatment and follow-up.

Keywords: Bilirubin, newborn, kernicterus, transcutaneous

Öz

Amaç: Çalışmamızda indirekt hiperbilirubinemili (İHB) hastaların tedavisinde noninvaziv, basit, hızlı ve ucuz bir yöntem olan transkütan bilirubin (TcB) ölçümü ile standart yöntem olan total serum bilirubin (TSB) ölçüm değerlerinin karşılaştırılması amaçlanmıştır. Ayrıca, çalışmaya eş zamanlı çalışılmış olan kapiller tüp bilirubin değerleri de dahil edilmiştir. Hastalarda İHB tedavisi öncesi ve sonrası TSB ve TcB düzeyleri arasındaki ilişkiyi araştırmayı amaçladık.

Gereç ve Yöntem: 1 Ocak - 1 Temmuz 2023 tarihleri arasında Gaziosmanpaşa Üniversitesi Tıp Fakültesi (Tokat, Türkiye) Yenidoğan Yoğun Bakım Ünitesinde İHB nedeniyle hastane yatışı yapılmış olan 37-42 haftalık hastalar çalışmaya dahil edildi. İHB için fototerapi alan hastalar retrospektif olarak değerlendirildi. TcB ölçümleri tedaviden, hemen önce ve 24 saat sonra (TSB ve kapiller tüp ölçümleri ile birlikte) patch ile kapalı kulaklardan yapıldı. İHB nedeniyle fototerapi uygulanan ve tedavi öncesi-sonrasında TcB, TSB ve kapiller tüp bilirubin düzeyleri değerlendirilen hastaların verileri retrospektif olarak analiz edilmiştir. Ölçümler tedavinin hemen başlangıcında ve 24. saatinde eş zamanlı yapılmıştır.

Bulgular: Yetmiş iki hasta term yenidoğandı. Altı hasta kriterleri karşılamadığı için çalışma dışı bırakıldı. Ortalama gebelik yaşı 37.23±0.60 hafta (37-40 hafta) ve ortalama ağırlık 2,751.52±432.84 g (2,100-4,550 g) idi. Yenidoğanların yirmi yedisi (%40,9) erkekti. Direkt Coombs testi beş yenidoğanda 1+ ve bir yenidoğanda 4+ olarak sonuçlanmıştır. Tedavi öncesi ve sonrası TcB bilirubin düzeyleri ve TSB ölçüm değerleri arasında istatistiksel olarak anlamlı bir fark vardı. Ayrıca, tedavi öncesi ve sonrası kapiller tüp bilirubin ve TSB ölçüm değerleri arasında istatistiksel olarak anlamlı bir fark vardı.

Sonuç: Çalışmamızda tedavi öncesi ve sonrası TcB ve kapiller tüp yöntemleri kullanılarak TSB bilirubin değerlerinde istatistiksel olarak anlamlı bir fark olduğu gösterilmiştir. TcB ve kapiller tüp yöntemleri İHB taramasında kullanılabilse de tedavi ve takip kararı için TSB ölçüm yöntemi yerine kullanılmasını öneremiyoruz.

Keywords: Bilirubin, yenidoğan, kernikterus, transkütan

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INTRODUCTION

Indirect hyperbilirubinemia (IHB) is a common disorder in newborns[1] and is estimated to occur in 60% of term and 80% of preterm newborns,[2] which is a physiological condition that often occurs in the postnatal period. It is not a major disease but a physical finding due to many causes. Severe IHB is considered pathologic. IHB is characterized by the accumulation of yellow-orange pigment bilirubin in the skin, sclera, and other tissues. Because IHB is not a specific disease and its causes are multiple different disorders, preventive and therapeutic approaches to IHB or hyperbilirubinemia are typically nonspecific.[3] All approaches to IHB aim to prevent kernicterus, which can occur due to increased unconjugated bilirubin levels. Kernicterus is a serious condition that may result in permanent damage. If kernicterus occurs, cerebral palsy, bilateral sensorineural hearing loss, and often upward gaze limitation are typically observed.[4] The 2004 American Academy of Pediatrics Hyperbilirubinemia Subcommittee guidelines recommend the total serum bilirubin (TSB) or transcutaneous bilirubin (TcB) measurement before hospital discharge to assess the risk of severe hyperbilirubinemia in all newborns.[5]

TSB measurement remains the gold standard method in IHB, but it is invasive and painful because it is performed by venous or heel blood sampling.[6]

Furthermore, despite the low risks associated with blood collection, the risks of complications such as iatrogenic anemia, puncture site infection, bacteremia, and osteomyelitis cannot be ignored.[7] TcB measurements estimate the total serum bilirubin levels using multi-wavelength spectral reflections from the skin surface.[8] Several studies have reported that the use of TcB or TSB measurements during IHB screening reduces the incidence of neonates with severe hyperbilirubinemia, the hospitalization rate for phototherapy, and the number of infants receiving phototherapy.[9-11] However, the accuracy of TcB measurements during phototherapy is lower than TSB. Therefore, TcB measurement is unreliable in neonates receiving phototherapy.[12-14] Differences may be seen between TcB measuring devices. If TcB is used instead of TSB measurement in the clinic, TcB values should be compared with TSB values, and their accuracy should be tested.[15]

For that reason, our study aimed to compare TcB measurement (a noninvasive, easy, fast, and inexpensive method) and TSB measurement values (the standard method for treating IHB). At the same time, CT bilirubin values were also included in the study for correlation purposes. We examined the correlation of TcB measurement with TSB values before and after treatment in patients followed up with a diagnosis of IHB.

MATERIAL AND METHOD

The study was carried out with the permission of Tokat Gaziosmanpasa University Ethics Committee (Date: 18.01.2024, Decision No: 83116987-038). All procedures were carried out in accordance with the ethical rules and the principles of the Declaration of Helsinki.

Newborns with gestational ages of 37-42 weeks who were hospitalized with IHB were enrolled between January 1, 2023, and July 1, 2023, in the neonatal intensive care unit of the Gaziosmanpasa University School of Medicine (Tokat, Türkiye). Patients with confirmed IHB were retrospectively investigated. Only term newborns (37-42 weeks) were included in the study. Newborns with congenital anomalies, applied exchange transfusion, previous phototherapy treatment, ABO-Rh blood group incompatibility, and pre/post-maturity were excluded from the study. Patients who received phototherapy for the first time and had no transfusion history were included in the study. In patients treated for IHB, TcB measurements were performed in patch-covered ears just before and 24th hours after treatment (at the same time as TSB and CT measurements). The data of patients who received phototherapy for IHB and whose TcB, TSB, and capillary tube bilirubin levels were measured before and after treatment were examined retrospectively. Six patients who did not meet the study criteria (due to a positive direct Coombs test) were excluded from the study. Bilirubin measurements were obtained simultaneously from routine data at the 0th and the 24th hours after the start of IHB treatment. TcB was determined by Bilicare (Gerium 2016, Israel) TcB-measuring device. Measurements from the right and left ears of each patient at pre- and post-treatment were analyzed and obtained from hospital records. The arithmetic mean of measurements taken from the right and left ears was combined into a single TcB value. Those with CT and TSB values were evaluated simultaneously. TcB values were also measured at the same time. The CT bilirubin values were measured using the ABL 800 Flex (195 µL, Danaver, 2200 Pennsylvania Avenue, NW). TSB values were determined using Roche Diagnostics adapted to COBAS 6000 AutoAnalyzer (Roche Diagnostics, Indianapolis, IN).

Statistical Analysis

Descriptive statistics were used to provide information about the general characteristics of the study groups. Data for quantitative variables are means and standard deviations (x±SD). Data for qualitative variables were defined using number (n) and percentage (%). One Sample T Test was used to examine whether the difference between variables differed from zero. P values were considered statistically significant when calculated to be less than 0.05. Ready-made statistical software was used in the calculations. (IBM SPSS Statistics 22, SPSS Inc., an IBM Co., Somers, NY, USA).

RESULTS

All 72 patients were term neonates. Sixty-six patients met the criteria. The mean gestational age was 37.23±0.60 weeks (37-40 weeks), and the mean weight was 2751.52±432.84 g (2100-4550 g). Twenty-seven (40.9%) neonates were male, and thirty-nine (59.1%) neonates were female. The direct Coombs (DC) test was also detected as 1+ in five neonates and 4+ in one neonate. These six patients (with positive DC)

who did not meet the study criteria were excluded from the study. All patients were delivered by cesarean section. 32 (31.9%) patients had 0 Rh+, 5 (6.9%) had B Rh, 24 (34.7%) had 0 Rh+, and 5 (% 6.9) patients had AB Rh+.

A statistically significant difference was observed between pre- and post-treatment TcB and TSB values (p<0.001; **Tables 1** and **2**).

Table 1. Accuracy of pretreatment TcB values compared to serum bilirubin values.

	Mean	Standard Deviation
TcB (mg/dL)	14.49	3.11
TSB (mg/dL)	13.67	2.90
Difference	0.8201	1.8787
95% Confidence Interval	(−2.86215) – (+4.502352)	
p	<0,001*	

N: Sixty-six (66), TcB: Transcutaneous bilirubin, TSB: Total serum bilirubin

Table 2. Accuracy of post-treatment TcB values compared to serum bilirubin values.

	Mean	Standard Deviation
Post-Treatment TcB (mg/dL)	11.11	3.10
Post-Treatment TSB (mg/dL)	10.64	2.80
Difference	0.4743	1.98391
95% Confidence Interval	(−3.41416) – (+4.362764)	
p	0,046*	

N: Sixty-six (66), TcB: Transcutaneous bilirubin, TSB: Total serum bilirubin

A statistically significant difference was observed between CT and TSB values pre- and post-treatment (**Table 3** and **4**).

Table 3. Accuracy of pretreatment capillary tube bilirubin values compared to serum bilirubin values.

	Mean	Standard Deviation
CT Bilirubin (mg/dL)	14.89	3.25
TSB (mg/dL)	13.67	2.90
Difference	1.22	1.57
95% Confidence Interval	(−1.86311) – (+4.301912)	
p	<0,001*	

N: Sixty-six (66), CT: Capillary tube, TSB: Total serum bilirubin

Table 4. Accuracy of post-treatment capillary tube bilirubin values compared to serum bilirubin values

	Mean	Standard Deviation
CT Bilirubin(mg/dL)	11.34	3.08
TSB(mg/dL)	10.64	2.80
Difference	0.71	1.35
95% Confidence Interval	(−1.94122) – (+3.352423)	
p	<0,001*	

N: Sixty-six (66), CT: Capillary tube, TSB: Total serum bilirubin

DISCUSSION

Our study analyzed the data of 66 newborn patients who underwent IHB treatment and had their measurements measured at the 0th and 24th hours. TSB was accepted as the gold standard and compared with TcB and CT method measurements. In our study, there was a statistically significant difference between pretreatment and post-treatment TSB measurements and TcB and CT. Our findings do not support using the TcB and CT bilirubin methods instead of the TSB method to determine treatment and follow-up, although they are used as pretreatment screening methods for IHB. Because there is no subgroup information on blood group incompatibility in the patients in our study, subgroup testing may yield different results.

IHB is a major disorder occurring in term newborns on the first day of life.[16] In the first week of life, 60-70% of term newborns are diagnosed with IHB, and an average of 85% of newborns admitted to the hospital in the first week of life are neonates diagnosed with IHB.[22] IHB is usually harmless and self-limiting. However, kernicterus may cause permanent damage to brain tissues due to very high bilirubin levels. Therefore, the diagnosis and treatment of IHB are critical.[17]

The gold standard method for diagnosing IHB is to measure TSB levels. Bilirubin values should be evaluated using the bilirubin nomogram based on the patient's age in hours. Nomograms can be used to track bilirubin values over time. It helps us predict which patients may develop hyperbilirubinemia in the future hours and days. TSB is regarded as the gold standard, but obtaining a good sample is not always possible, and the procedure can be painful. An alternative approach is the CT method, which requires a small blood sample. This method is less painful and more convenient.

Another alternative is to use TcB to assess bilirubin levels on the skin's surface. There is also the advantage of not having to provide a blood sample. This method reduces the frequency of severe hyperbilirubinemia and rehospitalization for phototherapy treatment. However, this method may give unreliable results in newborns undergoing phototherapy or newborns with dark skin.[28]

Neonates are commonly discharged early because of medical, social, and economic constraints. Shortening the duration of hospitalization in the neonatal period is correlated with the risk of rehospitalization due to hyperbilirubinemia. Early IHB diagnosis and treatment reduce morbidity. TcB measurement is frequently used to measure bilirubin levels for screening purposes to diagnose IHB. We compared TcB methods, a noninvasive, economical, and rapid method for early diagnosis, with serum and CT bilirubin, an invasive method.

TcB device is performed by spectral subtraction due to light absorption of bilirubin in isolation in capillary beds and subcutaneous tissue. TcB measurements are a fast, easy, noninvasive, and inexpensive method for detecting IHB.[21,23]

Gunaseelan et al. compared TcB sternum measurements with TSB measurements in a study on 400 newborns >35 weeks and found a significant correlation between them.[18]Similarly, Ho et al. found that TcB significantly correlates with TSB measurements in term or near-term neonates. TcB and TSB measurements were evaluated in a 997-term and near-term newborn sample. TcB showed 100% sensitivity and 56% specificity in the low- and intermediate-risk phototherapy groups, assuming the 75th percentile cut level of the Bhutani nomogram as the threshold.

Using above the 75th percentile for high-risk patients resulted in 86.7% sensitivity and 97.0% specificity.[19] In our study, the groups that received treatment comprised patients who scored 75% or higher on the Bhutani nomogram. Therefore, this explanation might be attributed to the statistically significant difference in TSB and TcB values in our study. Conversely, Maisels et al. and Rubaltelli et al. found a decrease in sensitivity when TcB had high cutoff measurement levels.[20,21]

Bhutani et al.[24] and Kolman et al.[25] also reported a significant correlation between TcB and TSB. Compared to these studies, the results of our study might be different since we just included the high-risk group for IHB.

A meta-analysis by Kate et al. showed a good correlation between TcB measurements before and during phototherapy and TSB in term and preterm newborns. They reported that the use of TcB before and during phototherapy was a reliable method; however, they stated that there is insufficient data to determine the safety of TcB after phototherapy. Therefore, they stated that for TcB to be the most reliable value during phototherapy, it should be measured on closed skin (the part of the body that does not receive phototherapy).[26]

A limitation of our study is that it did not include premature newborns. Jegathesan et al. reported that the TcB method is a noninvasive and reliable approach for screening hyperbilirubinemia before phototherapy in preterm infants born at 33-35 weeks of gestation. However, because the TcB method underestimates bilirubin levels after phototherapy in newborns born at <33 gestational weeks, TSB measurements are recommended to be preferred in the clinical decision-making process. When dealing with preterm infants born before 33 weeks of gestational age, the TcB method should be used with caution because their TSB levels may be near the phototherapy threshold. After phototherapy has begun, clinical decisions should be made based on TSB measurements because most preterm newborns require phototherapy within the first or second day of life.[27]

Increasing the number of patients, including newborns under 35 weeks of gestation, may impact the outcomes. Furthermore, our study only included the high-risk group based on the Bhutani nomogram so that the results may differ in the low- and intermediate-risk groups.

Study Limitations

In our study, pre- and post-mature neonates, black race, blood exchange, and normal vaginal birth patients were not included. The results may differ when included in the study.

CONCLUSION

Our study found a statistically significant difference between bilirubin values of TSB with TcB and CT methods both before and after treatment. Although TcB and CT methods can be used in IHB screening, we cannot recommend using them instead of the TSB measurement method in terms of treatment and follow-up.

ETHICAL DECLARATIONS

Ethics Committee Approval: The study was carried out with the permission of Tokat Gaziosmanpasa University Ethics Committee (Date: 18.01.2024, Decision No: 83116987-038).

Informed Consent: Because the study was designed retrospectively, no written informed consent form was obtained from patients.

Referee Evaluation Process: Externally peer-reviewed.

Conflict of Interest Statement: The authors have no conflicts of interest to declare.

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Author Contributions: All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

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Original Article / Orijinal Araştırma

Current follow-up results of Cyanotic Congenital Heart Diseases detected during Pregnancy in a specific Region

Gebelikte Belirli Bir Bölgede Tespit Edilen Siyanotik Konjenital Kalp Hastalıklarının Güncel Takip Sonuçları

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Abstract

Aims: Congenital heart disease (CHD) is the main cause of death in infants among congenital anomalies. Fetal echocardiography is important for the diagnosis and treatment plan of congenital heart diseases in the prenatal period. This study aimed to retrospectively screen the follow-up and treatment results of cyanotic CHD patients detected on fetal echocardiography.

Material and Method: Fetal echocardiography results were scanned from the hospital record system. Data of fetuses with major cardiac anomalies and cyanotic CHD were examined retrospectively.

Results: Fetal echocardiography was performed on 420 pregnant women between July 2020 and April 2023. Major cardiac anomalies and cyanotic heart disease were detected in the fetuses of 40 pregnant women (9.5%) out of 420. The median age of the pregnant women was 29 (19-41 years). The median gestational age at check-up was 23 weeks (22-28 weeks). 9/40 pregnant women (22.5%) had risk factors. The most common cyanotic congenital heart diseases were hypoplastic left heart syndrome (HLHS) and unbalanced complete atrioventricular septal defects (AVSDs) with obstructive lesions of the right or left ventricle. Three fetuses (7.5%) with heart failure findings died intrauterine. Two fetuses with HLHS and critical aortic stenosis (AS) died before being operated on. A patient with complete AVSD, hypoplasia of the left heart chambers, AS, and severe aortic coarctation died due to sepsis during the post-operative follow-up period. Chromosome analysis was performed in 8 patients. Down syndrome was detected in 3 of the patients with complete AVSD. 22q11 deletion and DiGeorge Syndrome were detected in 2 patients with tetralogy of Fallot.

Conclusions: Congenital heart diseases and rhythm problems can be safely detected with fetal echocardiography. It is beneficial to perform a fetal echo scan at the appropriate gestational week, especially in fetuses with risk factors and in whom the four chambers view cannot be seen.

Keywords: fetal echocardiography, prenatal screening, cyanosis, congenital heart disease

Öz

Aim: Konjenital kalp hastalığı (KKH), konjenital anomalili bebeklerde önde gelen ölüm nedenidir. Fetal ekokardiyografi konjenital kalp hastalıklarının prenatal dönemdeki tanı ve tedavi planı açısından önemlidir. Bu çalışma ile fetal ekokardiyografide saptanan siyanotik KKH hastalarının takip ve sonuçlarının retrospektif olarak taranması amaçlandı.

Gereçler ve Yöntem: Fetal ekokardiyografi sonuçları ekokardiyografi kayıt sisteminden tarandı. Major kardiyak anomali ve siyanotik KKH olan fetusların verileri geriye dönük incelendi.

Bulgular: Temmuz 2020-Nisan 2023 tarihleri arasında 420 gebeye fetal ekokardiyografi yapıldı. 420 gebenin 40'ının (%9,5) fetusunda majör kalp anomalisi ve siyanotik kalp hastalığı tespit edildi. Gebelerin ortalama yaşı 29 (19-41 yıl) idi. Ortalama gebelik yaşı 23 hafta (22-28 hafta) idi. Gebe kadınların 9/40'ında (%22,5) risk faktörleri vardı. En sık görülen siyanotik konjenital kalp hastalıkları hipoplastik sol kalp sendromu (HSKS) ve sağ veya sol ventrikülün obstrüktif lezyonlarıyla birlikte dengesiz tam atriyoventriküler septal defektlerdi (AVSD). Kalp yetmezliği bulguları olan 3 fetüs (%7,5) intrauterin dönemde kaybedildi. HLHS'li ve kritik aortik darlığı (AD) olan iki fetüs ameliyat edilmeden önce öldü. Komplet AVSD, sol kalp boşluklarında hipoplazi, AD ve ciddi aort koarktasyonu olan bir hasta, ameliyat sonrası takip sırasında sepsis nedeniyle kaybedildi. 8 hastaya kromozom analizi yapıldı. Komplet AVSD'li hastaların 3'ünde Down sendromu saptandı. Fallot tetralojili 2 hastada 22q11 delesyonu ve DiGeorge Sendromu tespit edildi.

Sonuç: Fetal ekokardiyografi ile konjenital kalp hastalıkları ve ritm problemleri güvenli olarak tespit edilebilmektedir. Özellikle risk faktörleri olan, dört boşluk net görülemeyen gebelerde uygun gebelik haftasında fetal eko taraması yapılmasında fayda vardır.

Anahtar Kelimeler: fetal ekokardiyografi, prenatal tarama, siyanoz, konjenital kalp hastalığı

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INTRODUCTION

Congenital heart disease (CHD) is the main cause of death in infants with congenital anomalies.[1] By identifying congenital heart diseases intrauterine, early diagnosis and treatment are possible by evaluating the heart structure, functions, and rhythm. One of the most effective screening methods is fetal echocardiography.

Although the incidence of congenital heart disease varies between countries, in a recent study conducted in middle Anatolia, the prevalence was 27.8 per 10,000 live births.[2] Besides, CHD is identified in approximately 1 percent of births, and accounts for 30 to 50 percent of deaths related to congenital anomalies in the United States.[3] In children with an isolated cardiac abnormality, the commonness of associated abnormalities also relies on the type of CHD. Cyanotic congenital heart diseases seem to have more adverse neurodevelopmental outcomes compared to acyanotic CHD.[4]

Fetal echocardiography is carried out in fetuses at a great risk of CHD and in fetuses who have or are doubted of having a pathology on routine ultrasound screening. However, even in low-risk patients, fetal echocardiography can also be performed in case of suspicion after routine screenings.[5]

Fetal cardiac anomalies can be divided into major and minor anomalies.[6] Major cardiac anomalies are cyanotic (heart defects with right-left shunt) like single ventricle, critical pulmonary and/or aortic stenosis, severe aortic coarctation, hypoplastic left heart syndrome (HLHS), dextro-transposition of great artery (D-TGA), etc. It includes heart diseases that require intervention as soon as birth, where prostaglandin-E1 (PGE1) infusion is frequently needed, or where normal physiology is disrupted, although there is no need for urgent intervention.

In this study conducted in the Eastern Mediterranean region, current fetal echocardiography results were scanned in a specific region, and data regarding cyanotic CHD were analyzed. There are very few recent studies in this region in the literature. This study was planned to retrospectively scan the fetal echocardiography results in the last 2 years and evaluate cyanotic congenital heart diseases, which are major cardiac structural anomalies, and follow-up treatment results.

MATERIAL AND METHOD

The study was carried out with the permission of Mersin University Clinical Researches Ethics Committee (Date: 01.11.2023, Decision No: 748). All procedures were carried out in accordance with the ethical rules and the principles of the Declaration of Helsinki.

The data of pregnant women who were cared for in the pediatric cardiology clinic and underwent fetal echocardiography between July 2020 and April 2023 were examined retrospectively.

Fetal echocardiography at a median week of 22 weeks (19-35 weeks of gestation) in the intrauterine period had been done. In the postnatal period, echocardiographic examination was repeated in fetuses with cyanotic CHD.

Fetal echocardiography was performed with the Vivid E9 Pro Ultrasound System (GE Medical Systems, Canada) with a 4C-RS convex ultrasound probe in the 1.6 to 4.6 MHz range. It was performed with 2D, M-mode, color Doppler, and pulse wave (PW) Doppler imaging methods. Four-chamber, five-chamber, three-vessel, ductal arch, and aortic arch positions were evaluated in two-dimensional imaging.

Transthoracic echocardiography, performed via Vivid E9 Pro Ultrasound System (GE Medical Systems, Canada) by using 3 and 6 MHz transducers as 2D, M-mode and colored Doppler, conventional continuous-wave (CW) and pulse wave (PW) Doppler visualizing methods. Two experienced pediatric cardiologists carried out all the studies.

Patients who were diagnosed in our center and came for follow-up and check-ups regularly were included in the study. Patients without complex congenital heart diseases were not included in the study. Those with simple CHD with left-right shunt diseases were not included in the study. Patients who were not initially diagnosed in our center and did not attend regular follow-ups were excluded from the study.

Statistical Method

Descriptive statistical methods were used to analyze the data expressed as numbers and percentages. Analysis of the data collected in the study was carried out using SPSS Statistics for Windows 16.0 (SPSS Inc., Chicago, IL, USA).

RESULTS

A total of 420 pregnant women were examined between the specified dates. Major cardiac anomalies with cyanotic heart disease were detected in the fetuses of 40 pregnant women out of 420 (9.5%). The median age of the pregnant women was 29 years (19-41 years). The median gestational age at check-up was 23 weeks (22-28 weeks). 9/40 pregnant women (22.5%) had risk factors. Two of the pregnant women had diabetes mellitus diagnosed during pregnancy. Maternal obesity was present in five pregnant women. Only one pregnant woman had a twin pregnancy. One pregnant woman had in vitro fertilization (IVF) with external assistance. None of the pregnant women had a history of CHD in their family, siblings, and/or first-degree relatives such as parents.

When the most common cyanotic heart diseases are summarized, there were 7 patients (17.5%) with HLHS, 6 patients (15%) with unbalanced complete atrioventricular septal defect (AVSD) with right or left ventricular outflow tract obstructions, 4 patients (10%) with tricuspid atresia, 4 patients with tetralogy of Fallot, and 5 patients (%12.5) with critical aortic valvular stenosis (AS) and/or severe aortic coarctation (AC). The distribution of all other diseases is summarized in **Table 1**.

Table 1. Characteristics of Cyanotic Congenital Heart Diseases diagnosed in Fetal Period.

Fetal Echocardiography Results	Number	PGE1 İnfusion	Survival
Hypoplastic Left Heart Syndrome	7	yes	All exitus
D-TGA	3	yes	
Unbalanced Complete AVSD with LVOT or RVOT obstruction	6	yes if alive	3/6 exitus
Tricuspid atresia with LVOT or RVOT obstruction	4	yes	
Tetralogy of Fallot	4	no	
Aort coarctation (AC)	1	yes	
VSD and AC	1	yes	
critical valvular AS	2	yes	2 exitus
valvular AS with AC	1	yes	
Double inlet single ventricul+ aortic interruption	1	yes	
Single ventricle with PA	2	yes	
VSD and PA	1	yes	
ciritical PS, PA	1	yes	
DORV	2	no	
Trunkus arteriozus	2	no	
Ebstein anomaly	2	no	

AS: Aortic stenosis, DORV: Double outlet right ventricle, D-TGA: D-Transposition of Great arteries, LVOT: Left ventricle outflow tract, PA: Pulmonary Atresia, PGE1: Prostaglandin-E1 infusion, PS: Pulmonary stenosis, RVOT: Right ventricle outflow tract. VSD: Ventricular septal defect.

Additional non-cardiac anomalies were detected in the gastrointestinal, central nervous system, and/or genitourinary system in seven patients (17.5%). Two patients with complete AVSD had major intestinal disorders. Three patients (one with tetralogy of Fallot, one with tricuspid atresia, and one with hypoplastic left heart syndrome) had slightly enlarged lateral ventricules of the brain. The last two patients had moderate to large renal calyceal dilation of whom two had aortic coarctation. No additional major systemic disorders were observed in other patients.

Intrauterine and postnatal outcomes

During the follow-up of the patients, three fetuses (7.5%) of whom one was with unbalanced AVSD and isthmus hypoplasia, one fetus was with complete AVSD and pulmonary atresia, Down syndrome, and major intestinal disorder, and one fetus with critical AS and cardiomyopathy died intrauterine.

While 32 of these patients (80%) were born in a pediatric cardiovascular surgery center (CVC), two pregnant women with HLHS gave birth in their local center, even though the must-to-do conditions were explained. A total of six patients with tetralogy of Fallot, double outlet right ventricle (DORV), Ebstein anomaly, and no additional vascular anomalies gave birth in non-CVC centers.

When the results and prognosis in the postnatal period are evaluated; postnatal echocardiograms of the patients were compatible with prenatal results. The patient with Ebstein's anomaly, who gave birth in a center without CVS, was considered to have functional pulmonary atresia, and PGE1 infusion was started because newborn was significantly cyanotic, and the patient was referred to the surgical center. There were no additional problems in other patients with tetralogy of Fallot. The ventricular septal defect (VSD) of the one patient with DORV was large, and when signs of heart failure still appeared on the 30th postnatal day, the patient was operated for pulmonary banding.

Among the patients referred to the surgical center, 2 with HLHS and critical AS died before being operated on. In sum, all seven patients with HLHS died before or after surgery. A patient with complete AVSD, hypoplasia of the left heart chambers, aortic stenosis, and severe aortic coarctation died due to sepsis during post-operative follow-up. Necessary surgical procedures were performed on other patients during their follow-up, and there were no losses in these patients in the post-operative acute period. The total mortality rate was 12/40 (30%).

Chromosomal Analysis

Chromosome analysis was performed in 8 patients. Down syndrome was detected in 3 of the patients with complete AVSD. 22q11 deletion and DiGeorge Syndrome were detected in 2 patients with tetralogy of Fallot. A total of 3 patients with HLHS were evaluated for chromosomal anomaly upon request of the family, but no anomaly was detected.

DISCUSSION

Cyanotic CHDs, among the major cardiac anomalies, are important heart diseases that need to be followed in the intrauterine and postnatal periods. By making a diagnosis in the intrauterine period with fetal echocardiography, necessary precautions such as pregnancy follow-up and subsequent birth planning can be taken in the pediatric CVS center. Our results show that particularly pronounced complex pathology and cyanotic CHD can be seen in patients, regardless of risk factors such as diabetes mellitus and maternal obesity. Four-chambers view, left and right ventricular outflow-tract views [LVOT and RVOT], and three-vessel-and-trachea views should be routinely performed by ultrasonographers, especially during pregnancy ultrasounds. It has been observed that the prognosis may be worse in cases of stenosis that involve the left heart chambers, aortic valve, and aorta, due to heart failure. This study is important in terms of showing the contemporary fetal echocardiography screening results and effectiveness of the fetal screening. It is also important in that it provides information about the prevalence of major cardiac anomalies by covering a specific region.

Compared to previous CHD incidence/prevalence studies; Although the rate of cyanotic CHD was not very low in this study, not every patient who underwent prenatal screening was sent for cardiac evaluation, and it is thought that the prevalence would be lower if all other pregnant women were included.[7]

The most common cyanotic congenital heart diseases were HLHS and unbalanced complete AVSDs with obstructive lesions of the right or left ventricle. When we look at the literature and especially neonatal studies, in a study conducted in Africa, tetralogy of Fallot and truncus arteriosus are the most common congenital heart diseases.[8] In our study, HLHS was ranked first, followed by unbalanced AVSD. Although no generalization can be made because the sample was small, the distribution of the results in the eastern Mediterranean region was like this. HLHS and unbalanced complete AVSD were common cyanotic CHDs, and they were referred to pediatric cardiology because the 4-chamber image was not obtained in the first scan. In cyanotic CHDs such as tetralogy of Fallot and BAT, positive results were obtained by examining 3-vessel imaging in addition to five-chamber (left and right ventricular outflow-tract views) imaging. Therefore, as stated in other studies, looking at all 3 positions in the first scan will increase the scanning efficiency.[9]

Performing fetal echocardiography in high-risk pregnancies has been recommended in many studies.[10] Even low-risk pregnancies may have accompanying cardiac anomalies. Therefore, fetal echocardiography screening seems important. In our study, 77.5 % of the pregnant women with major cardiac anomalies were low-risk pregnancies.[11] Even if there is no significant difference between high- and low-risk midwifery, a larger number of studies are needed.

In a study examining fetal autopsy results and comparing them with fetal echocardiography results, pathologies related to pulmonary veins and other vascular structures were rarely missed.[12] There was no patient missed in this way in our study. We think that it is especially important to evaluate the opening of the pulmonary veins, coronary sinus, superior vena cava, and the inferior vena cava (IVC).

When the mortality results were evaluated, losses were observed in three fetuses accompanied by cardiomyopathy and syndromic diseases. Fetal interventions like aortic or pulmonary balloon valvuloplasty, and/or atrial needle septoplasty can be performed in some patients. These fetal interventions could have also high mortality, and success rates depend on the patient, congenital heart pathology, and timing of the process. Significant heart failure in fetus could increase the mortality rates of these procedures.[13] In our country, interventions have started in some centers. In our study, although intervention was considered for two patients with critical aortic stenosis, no intervention was performed because the risk of mortality would be high due to significant heart failure. It is thought that as experience in fetal intervention increases, the number of procedures will increase.[14]

It is not necessary to start PGE1 infusion in every patient with cyanotic CHD in the postnatal period. However, it is necessary to be prepared for any situation, keeping in mind that postnatal physiology may change. The patient with Ebstein anomaly had to start PGE1 infusion due to functional pulmonary atresia in the postnatal period.

When looking at the prognosis of cyanotic CHD; In cases of critical aortic stenosis and/or aortic coarctation, especially affecting the left heart chamber, there have been patients who died due to pre-operative heart failure, cardiogenic shock or sepsis, and heart failure after the operation. In cases where the left heart chambers are affected, myocardial involvement may be more pronounced and the prognosis may be worse. Other studies have also reported that the prognosis is poor in patients with lower z scores, especially in cases where the size of left heart structures such as the mitral valve, aortic annulus, and left ventricle decreases.[15] Similarly, in this study, the prognosis was poor in patients with prominent hypoplasia. Although there is mostly no significant heart failure in the intrauterine period in right ventricular pathologies such as pulmonary valve critical stenosis, these patients are generally treated gradually in the postnatal period, going through two stages, starting with Blalock-Taussig (BT) shunt or patent ductus arteriosus (PDA) stent. In other studies, these patients generally did not require any intervention during the intrauterine period.[16,17] The mortality rate in this study represents both intrauterine and postnatal postoperative results, so the high ratio could be related to this.

Although chromosome analysis is not recommended for every cyanotic congenital heart disease, it seems logical to perform chromosome analysis in patients with additional risk factors and additional anomalies.[18] In our study, the possibility of syndrome and chromosomal anomalies seems to be increased in certain cyanotic CHDs such as AVSD and conotruncal anomalies.

Study Limitations

The fact that it is a retrospective study in a single center and the relatively small number of samples can be considered among the limitations of the study. Nevertheless, it is important because it shows data about cyanotic CHDs in patients who underwent fetal echocardiography in a certain region. Although the rate of cyanotic CHD was high in this study conducted in the Eastern Mediterranean region, this may be because not all patients were sent to the cardiology clinic.

CONCLUSION

With fetal echocardiography, major cardiac anomalies and cyanotic CHDs can be diagnosed and follow-up treatment plans can be made in the intrauterine and postnatal periods safely. These patients with major cardiac anomalies should be offered delivery primarily in pediatric CVS centers, as they may not be stabilized for transport. The risk of mortality is higher in both the intrauterine and postnatal periods of patients in whom the left heart structures are affected and/or there are genetic syndromes. The course of disorders

affecting the right heart structures, especially the pulmonary valve, may be better in the prenatal and postnatal periods. Chromosomal analysis and additional anomaly screening should be recommended in these patients with cyanotic CHD.

ETHICAL DECLARATIONS

Ethics Committee Approval: The study was carried out with the permission of Mersin University Clinical Researches Ethics Committee (Date: 01.11.2023, Decision No: 748).

Informed Consent: All patients signed the free and informed consent form.

Referee Evaluation Process: Externally peer-reviewed.

Conflict of Interest Statement: The authors have no conflicts of interest to declare.

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Original Article / Orijinal Araştırma

Türkiye's First Multidisciplinary Gene Therapy Education Program: History and Plans for the Future

Türkiye'nin İlk Multidisipliner Gen Tedavisi Eğitim Programı: Geçmiş ve Geleceğe Yönelik Planlar

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Abstract

Aim: Gene therapy is applied to regulate the functions of mutated or disease-causing genes in human cells and targets nucleotides. Recent years have seen an increasing number of publications reporting successful results from gene therapies, suggesting an increasing scientific curiosity among clinicians.

Material and Method: Gene Therapy Symposiums were hosted by the [blinded for review]. The participants answered pre-post-tests, and satisfaction scales.

Results: A total of 192 participants underwent training, none of whom had previously undergone gene therapy training. Of the sample, 71.9% were female and the median age of the participants was 32 years. Of the total, 84.9% were studying medicine and 15.1% were studying in non-medical fields. Among those studying medicine, 17.2% were students, 18.4% were main specialty research assistants, 38.0% were subspecialty research assistants, 17.2% were specialists and 9.2% were assistant professors/professors. An analysis of the completed pretests revealed that 32.3% had answered the questions correctly, while 58.6% answered the questions correctly after undergoing training. The overall satisfaction score was 91.8 out of 100.

Conclusion: The results of the pretest revealed the knowledge and awareness of gene therapy among the participants to be low, indicating a need for education programs addressing the subject. Gene therapy has moved beyond the theoretical realm in recent years and is today seeing practical applications. There is an urgent need to train the clinicians and other operatives required for the provision of gene therapies and to develop strategies for tertiary care centers in this field over the next 10 years.

Keywords: Education, future, gene therapy, inherited metabolic disorders, spinal muscular atrophy

Öz

Amaç: Gen terapisi, insan hücrelerinde mutasyona uğramış veya hastalığa neden olan genlerin fonksiyonlarını düzenlemek için uygulanan ve nükleotidleri hedef alan bir tedavi yöntemidir. Son yıllarda gen terapisi alanında başarılı sonuçlar bildiren yayınların sayısı artmış, bu da klinisyenler arasında bilimsel merakın artışına sebep olmuştur.

Gereç ve Yöntem: Gen Terapisi Sempozyumları [blinded for review] ev sahipliğinde düzenlendi. Katılımcılar ön-son testleri ve memnuniyet ölçeklerini yanıtladılar.

Bulgular: Hiçbiri daha önce gen terapisi eğitimi almamış olan toplam 192 katılımcıya eğitim verildi. Katılımcıların %71,9'u kadındı ve katılımcıların ortanca yaşı 32 yıldı. Toplamın %84,9'u tıp, %15,1'i ise tıp dışı alanlardandı. Tıp alanından katılımcıların %17,2'si öğrenci, %18,4'ü ana uzmanlık araştırma görevlisi, %38,0'ı yan dal araştırma görevlisi, %17,2'si uzman ve %9,2'si doçent/profesördü. Katılımcıların ön test analizinde soruların %32,3'ünü doğru yanıtladığı, eğitim sonrasında ise bu oranın %58,6'ya yükseldiği saptandı. Genel memnuniyet puanı 100 üzerinden 91,8'di.

Sonuç: Ön test sonuçları, katılımcılar arasında gen terapisine ilişkin bilgi ve farkındalık düzeyinin düşük olduğunu ortaya koymuştur ve bu da konuya yönelik eğitim programlarına ihtiyaç duyulduğunu göstermektedir. Gen terapisi son yıllarda teorik alanın ötesine geçmiştir ve bugün pratik uygulamalar görülmektedir. Önümüzdeki 10 yıl içinde gen tedavilerinin sağlanması için gerekli olan klinisyenlerin ve diğer uygulayıcıların eğitilmesine ve üçüncü basamak sağlık merkezleri için bu alanda stratejiler geliştirilmesine acil ihtiyaç vardır.

Anahtar Kelimeler: Eğitim, gelecek, gen tedavisi, kalıtsal metabolik hastalık, spinal muskuler atrofi

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INTRODUCTION

The idea of gene therapy was first brought to the table by Martine Cline in 1970 after she discovered that viruses transfer their genetic material to the host.[1] The subsequent development of recombinant DNA technologies made gene manipulation possible,[2,3] leading to the first application of human gene therapy for thalassemia[4] in 1982. Then, in 1990, two children diagnosed with severe combined immunodeficiency were subjected to gene therapy and subsequently cured of the condition.[5]

Gene therapy aims to regulate the functions of mutated or disease-causing genes in human cells and targets nucleotides.[6] In gene therapy, plasmids containing transgenes are transfected into the target cells. Since DNA is likely to be damaged during this process, the transfer is carried out through a vector that must carry the DNA fragment, must reach high concentrations, and must be specific to the target tissue, stable and effective, and provide long-term gene expression. The most commonly used viral vectors are adenovirus, adenovirus-associated virus (AAV), retrovirus/lentivirus and herpesvirus.[7]

Studies of gene therapy have witnessed a rapid increase in number since 2010, with over 30,000 publications related to gene therapy listed on PubMed in the last 3 years,[8,9] and a total of 33,406 studies involving clinical trials were conducted between 2010 and 2020.[9,10] Gene therapy research focuses on oncological and genetic diseases.[9] More than half of the gene therapy studies carried out over the last decade related to oncological and neurodegenerative diseases, while studies of hematological, immunological, inherited metabolic and cardiac diseases have gained popularity more recently. More than 25 percent of gene therapy studies of monogenic diseases relate to inherited metabolic diseases, and while most Phase 1 and Phase 2 clinical studies relate to cancer, Phase 3 clinical studies tend to favor genetic disorders.[9]

In recent years, with the increasing number of publications reporting successful results from gene therapies, the scientific curiosity of clinicians with an interest in genetic diseases has been raised.[11] Due to the high rate of consanguineous marriage in our country, the frequency of autosomal recessive monogenic diseases is relatively higher than in other countries,[12] and so developing the necessary infrastructure and providing the necessary training to healthcare personnel in gene therapy in the coming years is essential.

In the present study, we put forward a training program aimed at raising the awareness and knowledge of clinicians/researchers operating in various disciplines with an interest in monogenic inherited diseases that can benefit from gene therapy. To this end, gene therapy symposiums were organized with the financial support of a global grant, the success of which was measured based on the results of a satisfaction scale and pre- and post-tests applied to the participants. This is the first example of gene therapy training provided to a multidisciplinary cohort in our country.

MATERIAL AND METHOD

The three Gene Therapy Symposiums were hosted by the [**blinded for review**], with a 6-month interval between each, on 01.13.2023, 06.10.2023 and 12.8.2023. A Pfizer Global Independent Medical Education Grant RFP, Multidisciplinary Gene Therapy Education and Grant Program supported the project. The application of the RARE Center was one of hundreds made for such grants from all over the world and was the only application from Türkiye deemed worthy of the grant. The first of the symposiums was held face-to-face in [**blinded for review**], while the second and third were held online through a website with the [**blinded for review**] extension, which protects personal rights and contains features to prevent data theft.

The 7-hour/day training program included sessions with the following headings: "The History of Gene Therapy and its Story to the Present Day", "Preclinical Experiences for In-vivo Gene Therapy", "Clinical Considerations and an Overview of Gene Therapy" "Gene Therapy – the FDA/EMA Guide for Clinical Studies – the Situation in Türkiye", "Spinal Muscular Atrophy Clinical Program", "Hemophilia Clinical Program", "Immunodeficiency Clinical Program", "Clinical Program in Oncology", "AADC (Aromatic L-Aminoacid Decarboxylase Deficiency) Clinical Program", "OTC (Ornithine Transcarbamylase Deficiency) Clinical Program", "MLD (Metachromatic Leukodystrophy) Clinical Program" and "Preparations and Future Plans in Türkiye, given by experts in their fields.

To evaluate the benefits of the training program, the authors of the present paper prepared questions that were applied to the participants as pre- and post-tests. The pre-test was completed by the participants before joining the training, and the post-test was completed by the participants after the training. Participants accessed both tests via links sent to them and marked their answers electronically. The content of both the pre and post-tests consisted of questions related to the key points emphasized by the speaker on the topic and aimed at increasing awareness. The answers were analyzed as correct/incorrect. All the participants took part in a symposium satisfaction survey at the end of the symposium, with responses rated on a Likert type scale of 1–5, with "1" indicating the lowest satisfaction level and "5" indicating the highest satisfaction level. Satisfaction components included subject content, speakers, question-answer-discussion, symposium duration adequacy, contribution level to participant, preferred training method, preferred duration of training, willingness to participate in further training, willingness to recommend the program to friends working in the same field, and overall satisfaction score. The participants who were present throughout the training and who completed the final test were handed a "Gene Therapy Symposium Participation Certificate".

The Gene Therapy Symposium was the first multidisciplinary gene therapy training program to be conducted in Türkiye. The TTB STE/SMG Accreditation-Crediting Board accredited the Gene Therapy Symposium with 4.5 TTB STE/SMG Credits. The participants were able to obtain personal loans using their identification number through a link presented during the symposium. This study was conducted in accordance with the "Declaration of Helsinki". [**blinded for review**] Local Ethics Committee Approval number [**blinded for review**] was received on [**blinded for review**].

Statistical Analysis

IBM SPSS Statistics for Macintosh (Version 27.0. Armonk, NY: IBM Corp.) was used for all statistical analyses. Continuous and categorical variables were presented as medians [25th–75th percentiles] and numbers (percentage), respectively. A Chi-square test and a Fisher's test were used for the analysis of any differences between the independent groups. A p-value of less than 0.05 was accepted as statistically significant.

RESULTS

A total of 192 participants joined the training provided during the three gene therapy symposiums, none of whom had previously received training in gene therapy. Of the total, 71.9% were female, and the median age of the entire sample was 32 years [IQR: 25.0-38.0]. Furthermore, 139 of the participants (72.4%) were working in Ankara and 53 (27.6%) were working outside Ankara; and 163 (84.9%) were studying medicine and 29 (15.1%) were studying in non-medical fields. Of those studying medicine, 28 (17.2%) were students, 30 (18.4%) were main specialty research assistants, 62 (38.0%) were subspecialty research assistants, 28 (17.2%) were specialists, and 15 (9.2%) were assistant professors/professors. Among the non-medical fields represented were biology (27.5%), molecular biology (20.7%), pharmacy (13.8%), chemistry (13.8%), biotechnology (10.3%), nursing (6.9%), law (3.5%) and engineering (3.5%) (**Table 1**).

The pre- and post-tests were applied to the participants to evaluate the benefit of the training program. The pre-test was completed by the participants before the training, and the post-test was completed after the training. A total of 32.3% of the participants answered the questions correctly in the pre-test, and this figure increased to 58.6% after the training. The areas in which awareness/knowledge was raised the most were spinal muscular atrophy (pre-test and post-test correct answer percentages, 15.6% and 58.3%, respectively), ornithine transcarbamylase deficiency (13.8% and 43.8%, respectively), hemophilia (23.4% and 47.4%, respectively) and primary immune deficiencies (38.1% and 70.8%, respectively) (**Table 2**). The pre- and post-test data of the medical and non-medical professional groups were compared, revealing higher post-test scores among those working in the medical field than in those working in non-medical fields (61.1% vs 12.5% p=0.031).

Table 1. Sociodemographic characteristics of the participants

Sex, n (%)	
Female	138 (71.9)
Male	54 (28.1)
Age, years	
Mean (SD)	31.9 (8.6)
Median [IQR]	32.0 [25.0-38.0]
Min-max	18.0-63.0
City, n (%)	
Ankara	139 (72.4)
Outside Ankara	53 (27.6)
Geographic distribution of participation outside Ankara, n (%)	
Marmara region	12 (22.6)
Central Anatolian region	11 (20.8)
Aegean region	10 (18.9)
Mediterranean region	7 (13.2)
Black Sea region	5 (9.4)
Southeastern Anatolia region	5 (9.4)
Eastern Anatolia region	3 (5.7)
Fields, n (%)	
Medicine	163 (84.9)
Non-medicine	29 (15.1)
Title distribution of participants from the field of medicine, n (%)	
Student	28 (17.2)
Main specialty research assistants	30 (18.4)
Subspecialty research assistants	62 (38.0)
Specialist	28 (17.2)
Associate professor/professor	15 (9.2)
Distribution of clinicians by department, n (%)	
Main specialty research assistants (n=30)	
Pediatrics	18 (60.0)
Internal Medicine	6 (20.0)
Ophthalmologist	6 (20.0)
Subspecialty research assistants (n=62)	
Metabolism-Endocrinology	28 (45.1)
Immunology and Allergy	8 (12.9)
Neurology	8 (12.9)
Hematology-Oncology	7 (11.2)
Genetics	6 (9.6)
Gastroenterology	3 (4.8)
Pulmonology	2 (3.2)
Specialist and associate professor/professor (n=43)	
Metabolism-Endocrinology	19 (44.1)
Neurology	7 (16.2)
Genetics	6 (13.9)
Immunology	4 (9.3)
Hematology-Oncology	4 (9.3)
Neonatology	2 (4.6)
Ophthalmologist	1 (2.3)
Occupational distribution of participants from non-medical fields, n (%)	
Biology	8 (27.5)
Molecular Biology	6 (20.7)
Pharmacy	4 (13.8)
Chemistry	4 (13.8)
Biotechnology	3 (10.3)
Nursing	2 (6.9)
Law	1 (3.5)
Engineering	1 (3.5)

Table 2. Educational success of the symposium

	Pretest Correct answer rate (%)	Posttest Correct answer rate (%)
Spinal Muscular Atrophy Clinical Program	15.6	58.3
Ornithine Transcarbamylase Deficiency Clinical Program	13.8	43.8
Hemophilia Clinical Program	23.4	47.4
Primary Immunodeficiency Clinical Program	38.1	70.8
Aromatic L-Aminoacid Decarboxylase Deficiency Clinical Program	45.9	62.5
Metachromatic Leukodystrophy Clinical Program	45.3	59.4
Subjects outside the Clinical Program	44.4	67.7
Total score	32.3	58.6

Table 3. Satisfaction Scale

Subject content, score	4.63/5
Speakers, score	4.57/5
Question-answer-discussion, score	4.20/5
Symposium duration adequacy, score	4.30/5
Contribution level to participant, score	4.50/5
Preferred training method, %	
Face-to-face	60
Online	40
Preferred duration of training, %	
One day	60
Two days	40
Willingness to participate in further training, %	96.7
Willingness to recommend the program to friends working in the same field, %	100
Overall satisfaction score average	91.8/100

*Likert-type scale, from 1 (low) to 5 (high).

The post-test results of the academicians were higher than those of the students in the "hemophilia clinical program (52.4% vs. 17.8%, p=0.001)", "spinal muscular atrophy clinical program (34.7% vs. 14.2%, p=0.032)", "immunodeficiency clinical program (75.0% vs. 46.4%, p=0.002)" and "fundamentals (72.5% vs. 39.2%, p=0.001)".

A symposium satisfaction survey was administered to all participants at the end of the training in which the participants were asked to answer each question on a Likert-type scale of 1–5 for the lowest and highest satisfaction levels, respectively. The symposium topic content received an average score of 4.63/5, the speakers received an average rating of 4.57/5, the question-answer-discussion sections received an average rating of 4.20/5, the duration of the symposium averaged 4.30/5, and the contribution to the participants received an average rating of 4.50/5. When asked whether they preferred online or face-to-face education, 60% of the respondents preferred the face-to-face format. Furthermore, 60% of the participants stated that they would prefer the training to last one day, while 40% preferred the topics to be spread over two days. Some 96.7% of the participants stated that they thought the gene therapy symposiums should continue and declared a willingness to participate in further symposiums. All of the participants stated that they would recommend the training to their friends working in the same field. Finally, the participants were asked to give an overall satisfaction score to the symposium, resulting in an average of 91.8%.

DISCUSSION

Türkiye's first multidisciplinary gene therapy training symposiums were organized to increase the level of knowledge of the participants related to gene therapies, to open new horizons and to serve as a platform for discussions of current treatments. The targeted numbers of participants from both inside and outside Ankara were achieved, with participants from a broad range of disciplines other than medicine, including biologists, engineers, pharmacists, and lawyers. The pre-test results revealed the level of knowledge and awareness of gene therapy to be very low, suggesting the importance of education programs in the field of gene therapy. The pre-test and post-test data indicated a 1.8-fold increase in the knowledge level, while the correct answer rate in the post-test remained below 60%. For healthcare professionals from various disciplines and specialties, while listening to an expert in the field once can provide a certain level of insight, it is essential to attend repeated training tailored to subgroups within disciplines to stay updated on extremely new and current treatment methods. This encouraged us to continue improving ourselves in Gene Therapy education. Taking a holistic perspective, the post-test data indicates that continuing the training will further contribute to increases in awareness and knowledge, and almost all of the participants expressed a desire to see the training continue.

Spinal muscular atrophy (SMA) is a monogenic disease that is high on the agenda in our country, being an autosomal recessive hereditary disease characterized by progressive hypotonicity affecting the motor nuclei of the cranial nerves and anterior horn motor neurons in the spinal cord, it develops due to biallelic mutations in the SMN1 (MIM *600354) gene and has a reported frequency of 1–3/10,000 worldwide.[13] In Türkiye, the carrier frequency of the SMN1 gene mutation is 1/40–1/60, and although the exact incidence of SMA disease in Türkiye is unknown, the Ministry of Health of the Republic of Turkey suggests that there are 130–180 new cases annually, with approximately 3000 SMA patients under follow-up.[14] A premarital SMA carrier screening program was launched, in Türkiye in 2021, followed by a newborn SMA screening program in 2022.

Couples who apply for a premarital health report undergo spinal muscular atrophy carrier screening, while those who

are married can request it.[15] Being a disease caused by dysfunction of the SMN1 gene, gene therapy is considered a promising treatment option. The SMN1 gene is small and has been successfully packaged and transcribed with the help of a viral vector.[16] Adenovirus-associated virus serotype 9 (AAV9) is the preferred option for the transfer of the SMN1 gene, being a viral vector that can cross the blood-brain barrier.[17] There have been groundbreaking developments in the treatment of SMA disease in recent years, and gene therapy for SMA has emerged as a popular treatment approach in our country. The global follow-up of patients undergoing treatment is continuing to understand the long-term effects. Despite the disease being high on the agenda in Türkiye and the presence of a screening program in the country, only 15.6% of the participants of the symposiums gave correct responses in the field related to SMA in the pre-test applied before the start of Gene Therapy Symposium training, rising to 58.3% after the training, suggesting that the applied training raised awareness and knowledge of SMA. In our country, parents create calls for financial support for their children with SMA through many personal social media channels. Since the level of awareness of this issue in society is low, the clinical conditions of children diagnosed with SMA can sometimes be used for emotional exploitation by parents. Increasing the awareness and knowledge of physicians related to gene therapy is vital to achieving social improvement, both medically and socially, and the problem may be reduced through the involvement of trained physicians at events informing the public about SMA treatment options.

The majority of gene therapy research is in the field of inherited metabolic diseases, followed by eye and blood coagulation diseases, and these three disease groups combined account for more than half of all studies of gene therapies.[9,18] Our training symposium included training sessions on the diagnosis of ornithine transcarbamylase deficiency, aromatic l-amino acid decarboxylase deficiency and metachromatic leukodystrophy, which is an inherited metabolic disease. The ornithine transcarbamylase deficiency, aromatic l-amino acid decarboxylase deficiency and metachromatic leukodystrophy clinical programs increased the level of knowledge by 3.2, 1.4 and 1.3, respectively. It was observed that a higher proportion of physicians working in the field of metabolism participated in the training. Although OTC is an inherited metabolic disease, experiences and knowledge related to gene therapy are recent. For comparison, higher scores have been obtained in the field of primary immunodeficiencies, where gene therapy has been on the agenda for many years. This situation can be explained by the historical chronological process and accumulated experience. While only a quarter of the participants were aware of the hemophilia clinic program, half answered the questions correctly after the completion of the training, and their level of knowledge was doubled. It was initially intended to host a gene therapy session on eye diseases, however the lack of any academician working in this field in Türkiye led to the idea being abandoned. Should we continue the training series, this would be one of the main topics we would like to cover.

The satisfaction scale applied to the symposium participants revealed subject content to be the source of the greatest satisfaction, with scores of 4.5/5 and above being obtained regarding the speakers and their contributions to the program. The lowest score was achieved by the question-answer-discussion field, with 4.2/5 points, which may be attributed to the short amount of time allocated (5–10 minutes) due to the intensity of the training program. It should be noted that although 60% of the participants stated that the training should be held over a single day, the remaining 40% said that it should be a two-day program and spreading the program across two days would certainly allow a longer question-answer-discussion session to be accommodated. The program agenda reached a high satisfaction score of 91.8 out of 100, and although there are similar educational programs around the world, comparisons cannot be made since academic achievements are not shared in the form of an article. Increasing the knowledge and experience of the factors that contribute to educational success can be very valuable for the creation of content that best benefits academicians who will undergo training in gene therapy.

Our research reveals the characteristics and distribution of students, lab workers and academicians with an interest in Türkiye's first multidisciplinary gene therapy symposium program, and measures educational success and satisfaction. One significant reason for the lower-than-expected correct answer rates in the post-test may be the presence of participants from non-medical backgrounds. It was a limitation of our study. However, in our initial training program, we kept it open to all participants to promote awareness and advocacy. In the future, training sessions may be limited to the medical community to accurately measure medical knowledge. The discussion of experiences in gene therapies, which are gaining popularity worldwide, is vital for the academic community and for the raising of knowledge and awareness. Gene therapy has moved beyond the theoretical realm in recent years and is today seeing practical applications. The number of gene therapy products being used for the treatment of diseases is increasing daily. Aside from the approved therapies and those awaiting certification, there are also many clinical studies in the field suggesting a promising future for gene therapy.

In our country, where consanguineous marriages and autosomal recessive diseases are relatively common, there is a need for national strategies to support the necessary technological transformation, to reduce our external dependence on medicines, to ensure supply security, and to support the training of clinicians and other healthcare professionals in the field of gene therapy to support the operation of tertiary care centers over the next 10 years.

ETHICAL DECLARATIONS

Ethics Committee Approval: This study was approved by the Ankara University Faculty of Medicine Local Ethics Committee Approval number İ01-31-24 was received on 01.18.2024

Informed Consent: All patients signed the free and informed consent form.

Referee Evaluation Process: Externally peer-reviewed.

Conflict of Interest Statement: The authors have no conflicts of interest to declare.

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Author Contributions: All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

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Original Article / Orijinal Araştırma

A Determination of the Quality of Life of Patients with Vitiligo Using the Dermatological Life Quality Index

Vitiligolu Hastalarda Dermatolojik Yaşam Kalite İndeksi Uygulanarak Yaşam Kalitesinin Etkilenme Derecesinin Belirtilmesi

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Abstract

Aim: Vitiligo is a severe skin disease that significantly affects individuals' quality of life due to striking color changes in external appearance, and one that causes the majority of patients to feel stigmatized. This study was conducted to determine the effects of vitiligo on patients' psychological and social lives and to elucidate how they perceive the disease.

Methods: The research was conducted as an epidemiological study. The Dermatological Life Quality Index (DLQI) was applied to patients with vitiligo presenting to our clinic and to a control group.

Results: Fifty patients with vitiligo and 50 healthy individuals were enrolled. The vitiligo group consisted of 26 (52%) women and 24 (48%) men, and the healthy control group of 24 (48%) women and 26 (52%) men. The patients' mean age was 37.2±13.1 years, and that of the healthy controls 34.7±9.2 years. No significant age or sex differences were observed between the patient and control groups ($p<0.05$). The mean duration of the disease was 83.9±72.9 months. The most common vitiligo subtype was focal vitiligo, at 52%. The vitiligo and control groups' mean DLQI scores were 5.5±5.0 and 1.4±1.3, respectively, the difference being statistically significant ($p<0.05$)

Conclusion: The findings of this study show that the quality of life of the patients with vitiligo was significantly impaired compared to the control group.

Keywords: Vitiligo, quality of life, psychology

Öz

Amaç: Vitiligo, dış görünümde göze çarpan renk değişiklikleri nedeniyle kişinin yaşam kalitesini önemli ölçüde etkileyen ve çoğu hastanın kendisini damgalanmış hissetmesine yol açan ciddi bir cilt hastalığıdır. Bu çalışmada vitiligonun hastaların psikolojik ve sosyal yaşantılarına etkilerinin saptanması ve hastaların hastalığı nasıl algıladıklarının anlaşılması amaçlanmaktadır.

Gereç ve Yöntem: Çalışmamız epidemiyolojik bir çalışma olarak tasarlanmıştır. Polikliniğimize başvuran vitiligolu hastalara ve kontrol gruplarına dermatolojik yaşam kalitesi indeksi uygulandı.

Bulgular: Çalışmamıza 50 vitiligo hastası ve 50 sağlıklı kontrol grubu dahil edildi. Vitiligo hastalarının 26'sı (%52) kadın, 24'ü (%48) erkek'di. Sağlıklı kontrol grubunun 24'ü (%48) kadın, 26'sı (%52) erkek'di. Hastalarımızın yaş ortalamaları ve standart sapmaları 37,2±13,1, sağlıklı kontrol grubunun yaş ortalamaları ve standart sapmaları 34,7±9,2'di. Yaş ve cinsiyet açısından hasta ve kontrol grupları arasında istatistiksel olarak uyum vardı ($p<0,05$). Ortalama hastalık süresi ve standart sapması 83,9±72,9 ay olarak tespit edildi. Vitiligo klinik tipi olarak en sık görülen alt tip %52 ile fokal vitililigo oldu. Vitiligo ve kontrol gruplarında ortalama DYKİ skoru ve standart sapmaları sırasıyla 5,5±5,0 ve 1.4±1,3 olarak tespit edildi. Hasta grubumuzla sağlıklı kontrol grubu arasında istatistiksel olarak anlamlı bir fark bulundu ($p<0,05$).

Sonuç: Çalışmamızın bulguları vitiligolu hastalarda yaşam kalitesinin kontrol grubuna göre önemli düzeyde bozulduğunu göstermiştir.

Anahtar Kelimeler: Vitiligo, yaşam kalitesi, psikoloji

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INTRODUCTION

Vitiligo is a disease, the aetiopathology of which is still not fully understood, which progresses with the destruction of the melanocytes in the skin and which is characterised by well-defined, milky-white, depigmented macules on the skin.[1] It represents the most common cause of leukoderma, the probable global prevalence ranging between 0.1% and 2%.[2] Vitiligo can emerge in all age groups, but is most frequently seen between the ages of 10 and 30.[3] Although the etiopathogenesis is still unclear, the focus is currently on the autoimmune, neural, and autocytoxic hypotheses. The fact that vitiligo is seen together with several autoimmune diseases strengthens the autoimmune hypothesis.[4] The lesions sometimes follow a dermatomal area. This suggests that the neurochemical mediator response causes breakdown in melanocytes.[5] Clinically, vitiligo can be localized or generalized, the generalized form being more prevalent. It is characterized by lesions ranging from a few to widespread macules. These are frequently symmetrical and involve the extensor surfaces.[1]

The deleterious effects of dermatological diseases on patients' social relations, psychological states, and daily activities underline the importance and use of quality of life indices.[6] These are particularly important in terms of achieving a better understanding of patients' problems, monitoring post-treatment developments, and identifying clinical developments. Methods for measuring impairment caused by cutaneous diseases are needed for various reasons. They can be employed for comparison with systemic diseases, assessing the efficacy of new treatments, for evaluating the effectiveness of dermatology clinic services, for routine clinical follow-up, and for comparing the importance of different skin diseases and relative effectiveness of treatment.[7] The Dermatological Life Quality Index (DLQI) used in this study was first developed by Finlay and Khan. DLQI is one of the important and widely used tests specific to dermatology. It is suitable for daily clinical use, simple, sensitive, objective, and capable of use for all skin diseases. The DLQI also allows patients to reveal their problems and feelings and raises' physician's awareness of these.[8]

This study was conducted to determine the effects of vitiligo on the psychological and social experiences of patients using the DLQI, employed in several dermatological diseases, to elucidate how the patients perceive the disease, and to achieve a better understanding of their problems.

MATERIAL AND METHOD

The research was conducted as an epidemiological study. Fifty patients with clinically diagnosed vitiligo presenting to our clinic between April and August 2009 and 50 healthy controls with similar sociodemographic characteristics to those of the vitiligo group were enrolled. Inclusion criteria for the healthy control group were the absence of presentation to any physician within the previous three weeks and that the patients should have experienced no dermatological or systemic disease during that period. The questionnaire was explained to all the participants, and those consenting to take part were enrolled. Informed consent forms were obtained. Patients' age, sex, duration of disease, previously employed treatments, and presence of family history were investigated and recorded. The DLQI was applied to all participants to evaluate their quality of life. The form consisted of 10 questions with four possible responses, including symptoms and feelings, daily activities, spare time use, school/work life, personal relationships, and treatment was applied. The responses were the same for each question, with four possible options, the participants being asked to select only one. These were scored as follows: None/Never: 0, Slight: 1, High: 2, Very High: 3. Total DLQI scores (minimum 0, maximum 30) were calculated by adding the scores for each question. Total scores of 0–1 were interpreted as life being unaffected, 2–5 as being mildly affected, 6–10 as being moderately affected, 11–20 as being highly affected, and 21-30 as being extremely affected.

The study adhered to the tenets of the Declaration of Helsinki. Informed consent was obtained from all participants. Approved by the local ethics committee (13.03.2009/79-2)

Statistical Analysis

Data were analyzed with SPSS 14.0 program. Numerical data were expressed using mean, standard deviation and minimum-maximum values, and categorical data using frequencies and percentages. The chi–square test was applied in the analysis of categorical variables. Normality of distribution of continuous variables was assessed with the Kolmogorov–Smirnov test. Continuous variables in two independent groups were evaluated using Student's t–test when normally distributed and with the Mann–Whitney U test in case of non-normal distribution. One–way ANOVA was used if three or more groups were normally distributed, and Kruskal–Wallis test was used if distribution was not normal. The correlation of two continuous variables was shown with a scatter plot. Pearson correlation analysis was applied to determine the relationship between the duration of vitiligo and the DLQI. Statistical significance level was taken as $p<0.05$.

RESULTS

Fifty patients with vitiligo and 50 healthy individuals were enrolled in the study. Fifty-two percent (n=26) of the vitiligo group were women and 48% (n=24) were men, while 48% (n=24) of the control group were women and 52% (n=24) were men. Mean ages were 37.2±13.1 years in the vitiligo group and 34.7±9.2 in the control group. The two groups' mean ages were compatible. Age and gender distributions in the two groups are shown in **Table 1**.

Table 1. Age and gender distributions in the patient and control groups

	Vitiligo Patients	Control groups
Number	50	50
Gender (Female/Male)	26/24	24/26
Mean age (plus SD)	37.2±13.1	34.7±9.2
Age range	19–65	21–60

SD: Standard Deviation

The mean duration of the disease was 83.9±72.9 months, and a family history was present in 20% (n=10) of the 50 patients. The acrofacial type was present in 4% (n=2) of the patients, focal type vitiligo in 52% (n=26), generalized type in 36% (n=18), segmental type in 4% (n=2), and universal type in 4% (n=2). Thirty percent (n=15) of the 50 patients scored 0–1 on the DLQI (quality of life was unaffected), 26% (n=13) scored 2–5 (quality of life mildly affected), 26% (n=13) scored 6–10 (quality of life moderately affected), and 18% (n=9) scored 11–20 (quality of life highly affected).

The mean DLQI scores among the 50 patients with vitiligo and the 50 controls were 5.5±5.0 and 1.4±1.3, respectively, the difference being statistically significant (p<0.05) (**Figure 1**).

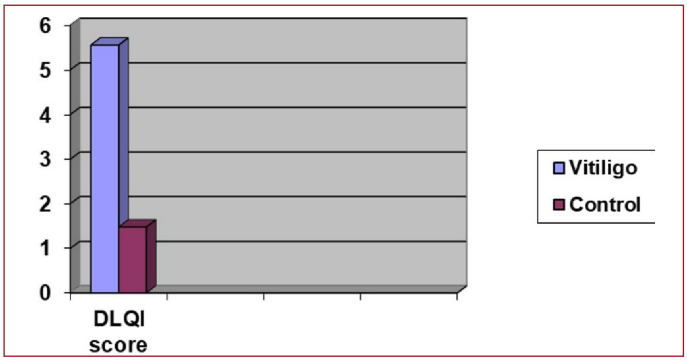

Figure 1. Mean DLQI scores of vitiligo and control groups

The mean DLQI score of the patients with focal type vitiligo was 4.3±4.0, compared to 7.2 ±6.3 in the generalized vitiligo group, the difference being statistically insignificant (p< 0.05).

A statistically significant association was determined between the duration of the disease of the vitiligo patients in this study and their DLQI scores (p<0.05) (**Figure 2**).

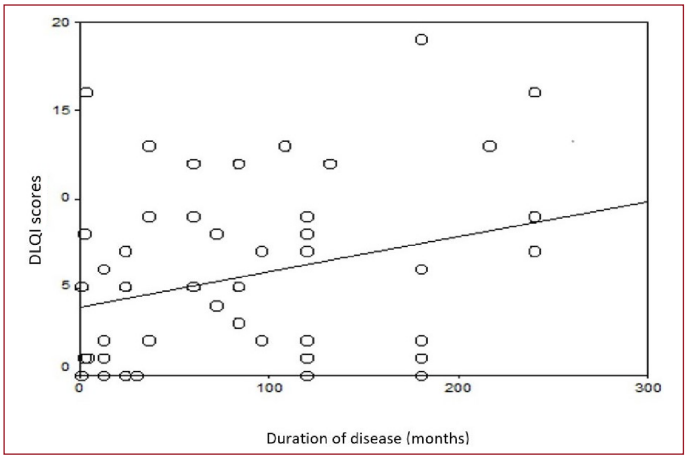

Figure 2. The relationship between duration of the disease and the DLQI scores

The DLQI subgroup scores of the patients in the study were 1.9±1.7 for symptoms and feelings (questions 1 and 2), 1.4±1.6 for daily activities (questions 3 and 4), 1±1.4 for spare time (questions 5 and 6), 0.8±1.1 for personal relationships (questions 8 and 9), 0.3±0.9 for school/work life (question 7), 0.2±0.6 for treatment (question 10). Significant differences were determined between the vitiligo patient and control groups in terms of all the DLQI subgroup scores. The highest score in both groups was in the symptoms and feelings subgroups, represented by questions 1 and 2. The two groups' mean DLQI subgroup scores and p values are shown in **Table 2**.

Table 2. The mean DLQI subgroup scores and p values in the vitiligo and control groups

	Vitiligo		Control		P
	Mean	SD	Mean	SD	
Feelings and symptoms (questions 1 and 2) Q1	1.9	1.7	0.9	0.8	P=0.01
Daily activities (question 3 and 4) Q2	1.4	1.6	0.3	0.6	P<0.05
Spare time (questions 5 and 6) Q3	1.0	1.4	0.2	0.4	P<0.05
Personal relationships (questions 8 and 9) Q4	0.8	1.1	0.1	0.2	P<0.05
School/work life (questions 7) Q5	0.3	0.9	0.0	0.0	P>0.05
Treatment (questions 10) Q6	0.2	0.6	0.0	0.0	P>0.05

SD: Standard Deviation

DISCUSSION

Vitiligo is typically characterized by clinically well-differentiated milky white depigmented cutaneous macules that progresses with generally asymptomatic selective melanocyte breakdown in the skin. It proceeds with remissions and flare-ups in correlation with triggering factors.[9]

The skin is the largest organ in the body, and one that plays a major role in sexual and social communication. Skin diseases can affect the patient's personality, social life, daily functions, and psychological state. They can lead to lack of confidence, shame, and embarrassment, and even to psychiatric diseases such as anxiety and depression. Patients can develop feelings such as shame and a sense of being different and lacking quality. Methods for measuring the impairment caused by skin diseases are needed for various reasons. For example, they can be used to enable comparisons with systemic diseases, to evaluate the efficacy of new treatments, to monitor the effectiveness of dermatology clinics, for routine clinical follow-up, and to assess the importance of different diseases of the skin and assess the relative efficacy of treatments. Vitiligo is one of the dermatological diseases capable of severely affecting patients' quality of life and leading to social isolation.[10]

This study therefore applied the DLQI to identify any impairment in the quality of life of patients with vitiligo.

Vitiligo is equally distributed between the sexes.[11] However, some studies have observed a greater prevalence in women.[12] This may be due to women more frequently seeking medical attention due to esthetic concerns. The female/male ratio in the present study was 1.083, a figure compatible with the existing literature.

A previous study reported a prevalence of vitiligo among first-degree relatives of 15.9%.[13] A family history was determined in 20 of the patients in the present study. Generalized vitiligo is the most widespread reported form in the literature.[14] In contrast to previous studies, however, focal vitiligo was observed in 52% of our patients, and generalized vitiligo in 36%.

The DLQI is also important because it allows patients to reveal their problems and feelings and also raise physicians' awareness of this condition. It is frequently employed in several dermatological diseases.

A previous study investigating the effects of treatment on DLQI scores in vitiligo patients determined a mean initial score of 10.6, decreasing to 7 after treatment.[15] This also shows that the DLQI can be effectively employed to assess the efficacy of treatment. The mean DLQI in that study was higher than our own figure (5.5±5.0). However, and similarly to the current research, a significant association was determined in that study between the duration of the disease and DLQI scores. We think that this may be attributable to the individual being less able to perform daily activities and being exposed to greater mental trauma the longer the disease persists.

Similarly, a previous study of 70 patients with vitiligo reported a mean DLQI score of 0–24.[16] In the present study, the mean DLQI score was 0-20. Daily activity subgroup scores were compared by gender in that study, the analysis revealing that women's daily activities were more impacted than those of men. In the present study, however, there was no statistically significant association between DLQI scores and gender.

Another study reported a mean DLQI score of 4.8±4.8 in patients with vitiligo.[17] This was lower than our own mean DLQI value, showing that our patients were more affected. In contrast to the present research, that study also found an association between the clinical disease type and the DLQI.

Studies have shown that more than half of patients with vitiligo are unable to easily establish relationships with the opposite sex, that the majority experience distress and embarrassment when they meet strangers or embark on an emotional and sexual relationship with a new partner, that many feel themselves to be the victims of rude or disparaging words, and that 15% of patients reported that vitiligo directly affected their sexual lives.[18]

When our patients were asked about the extent to which their skin had affected their sex lives in the previous week, one of the items on the DLQI, 8% (n=4) reported experiencing difficulties with their sex lives. We think that, although this figure is low, further multi-center studies with greater participation are now needed on this subject.

A previous study comparing the quality of life of psoriasis and vitiligo groups concluded that the quality of life of the vitiligo patients was less affected than that of the psoriasis group.[19] Although no comparison was performed with any other disease in the present study, we think that such comparisons will be useful in terms of evaluating the mental impacts of vitiligo.

While a statistically significant association was observed between sex and the DLQI in that study, no significant gender difference was observed in the DLQI scores in the present research. We think that since vitiligo is a dermatological disease capable of causing esthetic concerns by affecting the individual's appearance, this may explain the higher DLQI scores among women, who may attach greater importance to external appearance. Although no significant association between sex and the DLQI was observed in this study, we think that further studies with greater participation are needed on the subject.

Another study, of 109 patients with vitiligo, reported a mean DLQI score of 14.7, markedly higher than that in the current research.[20]

A study from Germany determined higher DLQI scores in vitiligo patients with large body surface areas affected by the disease.[21] However, no significant association was determined in the present study between the size of the area affected and DLQI scores.

CONCLUSION

The quality of life of the vitiligo group in this study was severely impaired compared with the healthy control group, and quality of life also decreased in line with the duration of the disease. Physicians should not regard vitiligo solely as an esthetic problem, and must display the requisite care in diagnosis and treatment by remembering that it also impairs the individual's quality of life. We think that recognizing and combating the psychosocial symptoms of vitiligo is important in terms of improving patients' quality of life of patients and achieving a better response to treatment.

ETHICAL DECLARATIONS

Ethics Committee Approval: The study was carried out with the permission of Atatürk University Faculty of Medicine Local Ethics Committee (Date: 13.03.2009, Decision No: 2-79).

Informed Consent: All patients signed the free and informed consent form.

Referee Evaluation Process: Externally peer-reviewed.

Conflict of Interest Statement: The authors have no conflicts of interest to declare.

Financial Disclosure: The authors declared that this study has received no financial support.

Author Contributions: All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

Note: This study was derived from a thesis by the corresponding author and appeared as an oral presentation at the 1st International Eurasian Dermato-venerology and Cosmetology Congress held on 08-12 June 2022.

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Original Article / Orijinal Araştırma

Acute Effect of Kinesio Taping Applied to Gastrocnemius Muscle on Jumping Performance in Athletes and Sedentary Individuals

Sporcu ve Sedanter Bireylerde Gastrocnemius Kasına Uygulanan Kinezyo Bantlamanın Sıçrama Performansına Akut Etkisi

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Abstract

Aim: This study aimed to investigate the acute effect of kinesio taping applied to athletes and sedentary individuals on vertical and horizontal jumping performances.

Material and Method: The study included 20 licensed male basketball players and 20 male sedentary individuals between the ages of 18-25. Vertical jump height and horizontal jump distance were evaluated. Free jumping and squat jumping tests were applied to measure the vertical jump height. Single leg hop test was chosen for the measurement of horizontal jump distance. Single leg hop test was performed with the dominant foot. Tests after kinesio taping were performed 10 minutes after facilitation technique was applied to gastrocnemius muscle.

Results: A comparison of the pre- and post-taping data in the athlete group revealed a significant increase in both squat jump and single leg hop tests ($p<0.05$). In the sedentary group, there was a significant increase only in the single leg hop test compared to before taping ($p<0.05$). All pretest and posttest values of the athlete group were higher than the sedentary group ($p>0.05$). In terms of the performance increases after kinesio taping, the increases in the athlete group were higher for all tests compared to the sedentary group ($p>0.05$).

Conclusion: Our study revealed that kinesio taping can improve jumping performance in both athletes and sedentary individuals. We think that kinesio taping could improve the performance especially in sports where jumping movements are frequently used such as basketball.

Keywords: Athlete, gastrocnemius muscle, kinesio taping, sedentary, jumping

Öz

Amaç: Bu çalışma, sporcu ve sedanter bireylere uygulanan kinezyo bantlamanın dikey ve yatay sıçrama performanslarına akut etkisini araştırmayı amaçlamıştır.

Gereç ve Yöntem: Çalışmaya 18-25 yaş aralığında lisanslı 20 erkek basketbolcu ile 20 erkek sedanter birey dahil edilmiş ve dikey sıçrama yüksekliği ve yatay sıçrama mesafesi değerlendirilmiştir. Dikey sıçrama yüksekliğini ölçmek için tek ayak üzerinde yapılan serbest sıçrama ve squat sıçrama testleri uygulanmıştır. Yatay sıçrama mesafesinin ölçümü için single leg hop testi seçilmiştir. Tek ayağın kullanıldığı testler dominant ayak ile gerçekleştirilmiştir. Kinezyo bantlama sonrası testler gastroknemius kasına fasilitasyon tekniği uygulandıktan 10 dk sonra yapılmıştır.

Bulgular: Sporcu grupta bantlama öncesi ile sonrası veriler karşılaştırıldığında hem squat sıçrama hem de single leg hop testlerinde anlamlı artış gözlendi ($p<0.05$). Sedanter grupta bantlama öncesine göre sadece single leg hop testinde anlamlı artış vardı ($p<0.05$). Sporcu grubunun tüm ön test ve son test değerleri sedanter gruba göre daha yüksekti ($p>0,05$). Kinezyo bantlama sonrası performans artışları açısından sporcu grubundaki artışlar tüm testlerde sedanter gruba göre daha yüksekti ($p>0,05$).

Sonuç: Çalışmamız, kinezyo bandın hem sporcularda hem de sedanterlerde sıçrama performansını artırabileceğini ortaya koymuştur. Özellikle basketbol gibi sıçrama hareketinin fazlaca kullanıldığı sporlarda kinezyo bantlamanın performansa etki edeceğini düşünüyoruz.

Anahtar Kelimeler: Gastroknemius kası, kinesio bantlama, sedanter, sıçrama, sporcu

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INTRODUCTION

The triceps surae muscle, the strongest flexor of the foot, consists of the gastrocnemius and soleus muscles. Although it terminates in the calcaneus, it continues its strength on the sole of the foot to the toes through a flat tendon called the aponeurosus plantaris.[1] Plantar flexion muscles are the main source of mechanical power production required in movements such as walking, running, and jumping.[2] Most of the sports branches have a jumping movement. In the vertical jump, the goal is to reach the highest, while in the horizontal jump, the goal is to reach the farthest. Ankle muscle strength is significant enough to affect performance in sports that frequently needs jumping.[3,4] Kinesio taping (KT) is an application that supports the structural feature and flexibility of human skin without limiting joint movement. KT, which can be applied in different ways and directions, is used both for therapeutic and rehabilitation purposes and to support the locomotor system in many professional sports.[5,6]

MATERIAL AND METHOD

Ethics committee approval (19-KAEK-017) was obtained for our research, and this study was conducted with licensed basketball players and sedentary male individuals between the ages of 18-25.

Jump lengths pre- and post- taping were measured in two groups, athlete and sedentary, and 40 people, 20 in each group, were included in the study with 80% power, 5% margin of error and 0.4 effect size. G*Power 3.1.9.4 software was used for the sample size. Individuals with pain, limitation of movement, orthopedic discomfort, incompatibility during the test, allergy to kinesio tape, and neuromuscular disease were excluded from the study. Age, height, body weight and body mass index (BMI) values of individuals were recorded. In the literature, it was reported that the minimum time required for KT to interact with the skin is 10 minutes. Therefore, the measurements in the present study were made 10 minutes after taping.[5,7] For the muscle application of the tape, facilitation technique was selected for performance increase. According to this technique, the band, which was given 50% tension during the application, was started and finished without tension at both ends. In order to facilitate muscle contraction, Y strip tape, which is applied to surround the muscle and is one of the most common application methods, was chosen (**Figure 1**).[5,7,8] In the tests performed before and after the tape application, the acute effect was observed by measuring the jump height and jump distance.

Figure 1. Applying kinesio tape to the gastrocnemius muscle

The free (vertical) jump test and squat jump test, in which hand marking was performed to measure the jump height, were used. The single leg hop test was used to measure the horizontal jump distance. The dominant lower extremity was preferred for one-legged tests. All tests and applications were carried out by the same physiotherapist. Participants were given two minutes between different tests to rest. Three repetitions were performed 30 seconds apart in each test. While the best result was recorded in the free jump test, the average of the three measurements was recorded in the squat and single leg hop tests.[9-11]

In the free jump test, the distance difference between the highest point that can be reached on the wall without leaving the feet off the ground and the highest point reached in vertical jump was measured (**Figure 2**).[9]

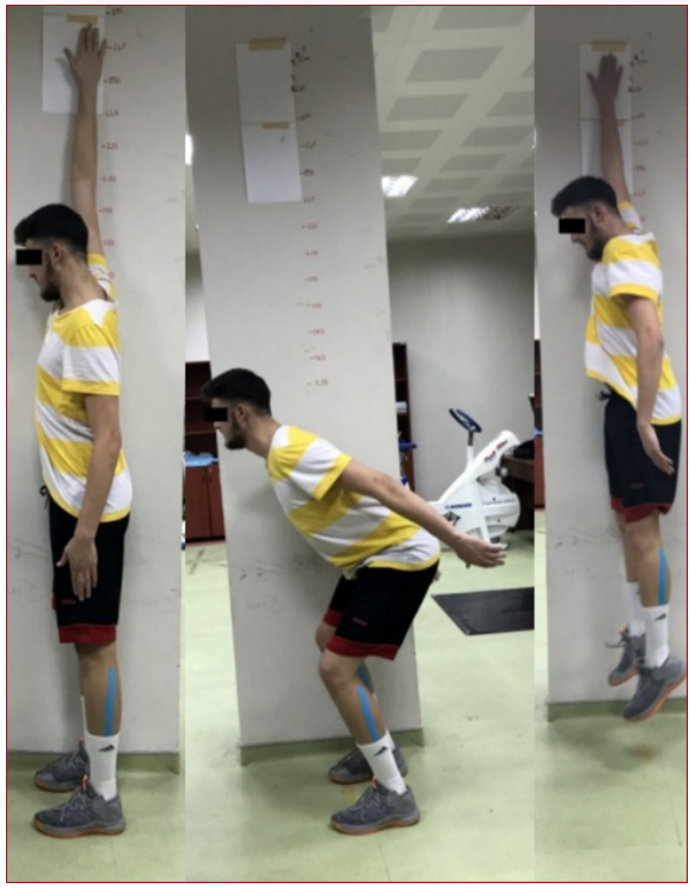

Figure 2. Vertical (free) jump test stages

Newtest Powertimer 300 device and its integrated mat were used in the squat jump test. Participants tried to reach the highest point they could jump without springing in the 90º squat position (**Figure 3**).[10]

In the single leg hop test, they jumped forward as far as possible using their dominant foot and arms, landing on the same leg and achieving balance (**Figure 4**).[11]

Figure 3. Vertical (squat) jump test stages

Figure 4. Horizontal jumping (single leg hop) test stages

Statistical Analyses

Parametric tests were preferred when investigating the differences in terms of the characteristics of the individuals. Performance differences between the two groups and before and after taping were examined. In addition, the individuals in the groups were categorized according to age, height, BMI, and dominant side characteristics. The normality tests of the variables were examined with the Jarque Bera test. Paired Samples t test was used to compare the differences of the dependent groups. Independent paired-sample t-test was used to compare the differences of independent groups, and Levene test was used for the homogeneity of variances. Pearson correlation analysis was used to examine the relationships between variables. P<0.05 was considered statistically significant in all analyses. Statistical analyses were performed using the IBM-SPSS 22 software. Only normality tests were performed using the Past software since SPSS does not have the Jarque Bera (JB) test.

RESULTS

The mean age, height, body weight and BMI values of athletes and sedentary individuals are given in **Table 1**. Fourteen individuals in the athlete group and sixteen individuals in the sedentary group used their right leg dominantly.

Table 1. Mean values of age, height, body weight and BMI of individuals

Variables	Athletes (n=20)	Sedentaries (n=20)	t	p
Age (year)	20.25 (±1.59)	20.45 (±1.54)	0.405	0.688
Height (cm)	185.80 (±6.66)	176.05 (±5.74)	4.960	<0.001
Weight (kg)	82.17 (±9.45)	72.94 (±8.79)	3.199	0.003
BMI (kg/m2)	23.84 (±2.37)	23.53 (±2.52)	0.406	0.687

Paired samples t test was used. p<0.05

An increase was observed in all individuals after taping for free, squat and single jump performance (**Table 2**).

Table 2. Difference Test Between Individuals' Jump Scores

Test	Kinesio-taping	n	Mean (cm)	Sd (cm)	t	p
Free	Before	40	50.58	5.39	2.187	0.035
	After	40	51.65	5.48		
Squat	Before	40	38.54	4.31	4.229	<0.001
	After	40	39.59	4.20		
Single	Before	40	167.71	15.11	6.027	<0.001
	After	40	172.28	17.11		

Paired samples t test was used. p<0.05

The results of the difference test between the pre- and post-KT jump scores of athletes and sedentary individuals are given in **Table 3**.

Table 3. Difference Test Between Jump Scores According to Groups

Groups	Test	Kinesio-taping	Mean (cm)	Sd (cm)	t	p
Athletes (n=20)						
	Free	Before	50.70	5.22	1.763	0.094
		After	52.15	5.29		
	Squat	Before	39.17	4.65	4.924	<0.001
		After	40.46	4.38		
	Single	Before	169.57	14.23	5.429	<0.001
		After	175.45	17.10		
Sedentary (n=20)						
	Free	Before	50.45	5.68	1.277	0.217
		After	51.15	5.75		
	Squat	Before	37.91	3.97	1.906	0.072
		After	38.71	3.92		
	Single	Before	165.85	16.09	3.249	0.004
		After	169.12	16.94		

Paired samples t test was used. p<0.05

Individuals were evaluated in two groups according to their height, 180 cm and below and 181 cm and above, and the effect of KT on jumping performance is given in **Table 4**.

Table 4. Difference Test Between Jump Scores According to Height in Individuals

Height	Tests	Kinesio-taping	Mean (cm)	Sd (cm)	t	p
80 cm and less (n=19)						
	Free	Before	49.95	5.45	1.402	0.178
		After	51.21	6.00		
	Squat	Before	37.52	4.43	2.661	0.016
		After	38.69	4.27		
	Single	Before	164.02	13.94	3.401	0.003
		After	167.49	13.08		
181 cm and up (n=21)						
	Free	Before	51.14	5.40	1.875	0.075
		After	52.05	5.08		
	Squat	Before	39.45	4.09	3.545	0.002
		After	40.40	4.06		
	Single	Before	171.05	15.67	5.115	<0.001
		After	176.62	19.37		

Paired samples t test was used. p<0.05

In athletes, an increase in jumping performance was observed after KT application in squat and single leg hop test ($p<0.001$) in those with a BMI below 25, while in those with a BMI of 25 and above an increase in jumping performance after KT was evident only in free jumping ($p<0.05$). In sedentary subjects, an increase in jumping performance was observed in squat and single leg hop tests in those with a BMI below 25 ($p<0.05$).

After KT, an increase in jumping performance was observed in all tests ($p<0.001$) in individuals with the dominant right leg, and only in the single leg hop test ($p<0.05$) in those with dominant left leg.

The pre- and post-KT jump performances of all individuals according to their age groups are given in **Table 5**.

Table 5. Difference Test Between Jump Scores According to Age in Individuals

Age (year)	Tests	Kinesio taping	Mean (cm)	Sd (cm)	t	p
18-19 (n=14)						
	Free	Before	50.79	4.46	1.963	0.071
		After	51.93	4.21		
	Squat	Before	38.77	3.80	3.157	0.008
		After	39.78	3.29		
	Single	Before	172.93	15.30	3.398	0.005
		After	177.38	17.19		
20 (n=9)						
	Free	Before	52.33	5.64	0.819	0.437
		After	53.78	6.12		
	Squat	Before	40.59	5.00	0.616	0.555
		After	40.89	5.52		
	Single	Before	172.70	16.87	2.237	0.056
		After	177.15	18.99		
21 (n=9)						
	Free	Before	48.00	3.97	0.540	0.604
		After	48.56	4.56		
	Squat	Before	37.51	3.43	2.203	0.059
		After	38.99	3.76		
	Single	Before	163.44	11.08	3.446	0.009
		After	168.07	14.57		
22 and up (n=8)						
	Free	Before	51.13	7.59	2.553	0.038
		After	52.25	7.01		
	Squat	Before	36.98	5.02	2.482	0.042
		After	38.47	4.80		
	Single	Before	157.75	12.16	2.788	0.027
		After	162.62	14.65		

Paired samples t test was used. $p<0.05$

DISCUSSION

Parameters such as jumping distance, leg strength and anaerobic power used in the evaluation of physical performance were reported to be closely related to age, gender, muscle type, muscle mass, heredity, body composition and training status. It is emphasized that regular training improves the performance of the individual and that physical characteristics are an effective factor on performance. Vertical jumping is an excellent indicator of lower extremity muscle strength in many sports. When the leg strength, vertical jump heights, flexibility and anaerobic power of young individuals were tested, a significant difference was observed between athletes and sedentary individuals.[12] In the evaluation of jump performance, vertical jumping is mostly evaluated.[13-15] The number of studies in which both horizontal and vertical jump are considered together is less.[4,16,17] There are many studies investigating the effects of KT on muscle strength, vertical jump, explosive force, pain, inflammation, blood circulation and tissue healing.[14,18-21] In order to measure vertical jump and horizontal jump performances, KT was applied on different muscles, and generally the quadriceps femoris muscle was evaluated.[16,17,19] In recent years, studies on KT on the gastrocnemius muscle have been increasing and facilitation technique is generally used.[14,18,22] In the present study, we evaluated the effect of KT applied to the gastrocnemius muscle by facilitation technique on horizontal and vertical jumping performances.

It was reported that the shortening of the muscle due to the effect of KT, which is applied with stretching from the origos to the insertion of the muscle, increases the muscle tone by activating the length-contraction mechanism and providing traction in the direction of contraction.[23,24] KT was hypothesized to facilitate momentary increases in muscle strength by providing a concentric pull on the fascia that can stimulate muscle contraction.[25,26] Another theory is that KT affects muscle strength by increasing muscle activity through facilitator action.[3,27] KT is used in athletes, rehabilitation and treatment due to its effect on muscle strength and jumping performance, supporting the muscular system, increasing muscle performance, and contributing to the tissue healing process. Ahn et al. (2015) reported that KT is effective in restoring the decreased muscle strength after muscle fatigue.[16] There are two different theories for the action mechanism of KT: it strengthens muscle and fascia functions by increasing blood circulation in the area where it is applied[23,29] and it influences the range of motion by stimulating cutaneous mechanoreceptors.[30,31] The application of tape on stretched skin facilitates motor function through cutaneous afferent stimulation, and the activation of stimulated α-motor neurons improves muscle performance after muscle fatigue induction.[32]

KT has significant implications for sports performances that require rapid production of high muscle strength.[29] In the literature, it was reported that there was no change in jumping performance 10 minutes after KT, but an increase in performance and muscle activity was observed after a few days.[15] In our study, on the other hand, an increase in jumping performance was observed in both sedentary and athlete individuals 10 minutes after taping.

A study conducted by Mostert-Wentzel et al. (2012) in young athletes concluded that KT improved vertical jumping. We reached similar conclusions in our study. Similar to our

findings, there are studies in the literature reporting a positive effect of KT on jumping performance.[4,18,28,34] Conversely, there are also studies showing that KT has no effect on jumping performance.[8,13]

Besides the studies that evaluated only horizontal jumping,[28,34] many of the studies examining vertical and horizontal jump performance like ours preferred the single leg hop test because it is a reliable and practical method.[4,16,17,22] Contrary to the reports indicating positive effects of KT on horizontal jumping,[4,16] there are also reports in the literature mentioning no such effects.[8,17,22] Ahn et al. (2015) observed a significant difference in healthy women whose quadriceps femoris muscle was supported with KT compared to those for whom KT was not applied, and suggested that it was an effective method to reduce muscle fatigue. We et al. (2019) found that the application of KT to the rectus femoris, biceps femoris, and gastrocnemius muscles in healthy individuals significantly improved horizontal jumping performance. Similarly, Alghamdi and Shawki (2018) observed positive effects of KT on horizontal jumping in athletes with ankle instability. Similar to these studies, we observed that KT increased horizontal jumping performance in both athletes and sedentary individuals. In the present study, vertical and horizontal jump performances were evaluated with three different tests, and a significant increase was observed after KT. We think that especially in athletes KT contributes to performance in the squat jump and single leg hop test, and supports muscle contraction with its fascia stimulating mechanism.

Studies considering the dominant legs is not common in the literature. In our study, we preferred the dominant foot in single-leg jumping, and we observed that athletes and sedentary individuals with a dominant leg on the right side achieved significant results in all three tests while those with a left dominant leg made a significant difference only in the single leg hop test. Macdowall et al. (2015) reported that KT provided a significant increase in static jump height on the dominant leg in athletes, suggesting that this effect may provide a significant advantage in sports such as basketball and volleyball.

In their study evaluating the jumping performance of young individuals, Bchini et al. (2023) found that muscle volume was higher in the 20-22 age group than in adolescents. They reported that jumping performance increased depending on muscle volume. Yıldırım and Ozdemir (2010) found similar results. Our results were similar to those in the literature. An explanation for this could be that the age-related increase in muscle volume and muscle strength in young people affects jumping performance. It was reported in the literature that both jump performance and anaerobic strength of tall people are better.[36,37] In terms of the association of performance with height, our results were similar to those reported in the literature.

CONCLUSION

Jumping is very important in many sports, especially in sports competitions that involve jumping. Jumping performance is very valuable in terms of influencing the success of the athletes and thus the outcome of the competitions. We think that our study dealing with the effectiveness of KT on both horizontal and vertical jump in athletes and sedentary individuals and compared performance of these two groups could contribute to the literature and sports activities.

ETHICAL DECLARATIONS

Ethics Committee Approval: The study was carried out with the permission of Tokat Gaziosmanpasa University Local Ethics Committee (Date: 05/12/2019, Decision No: 19-KAEK-017).

Informed Consent: All patients signed the free and informed consent form.

Referee Evaluation Process: Externally peer-reviewed.

Conflict of Interest Statement: The authors have no conflicts of interest to declare.

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Original Article / Orijinal Araştırma

Evaluation of the Frequency, Localization and Relationship of Maxillary Sinus Pathologies with Dental Pathologies by Cone Beam Computed Tomography (CBCT)

Maksiller Sinüs Patolojilerinin Sıklığı, Lokalizasyonu ve Dental Patolojiler ile İlişkisinin Konik Işınlı Bilgisayarlı Tomografi (KIBT) ile Değerlendirilmesi

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Abstract

Aim: The proximity of the root tips of the maxillary posterior teeth to the maxillary sinus causes odontogenic infection to become a potential source of maxillary sinusitis. This study aims to evaluate the relationship between dental pathologies and maxillary sinus abnormalities using cone beam computed tomography (CBCT).

Material and Method: In this study, 300 patients who applied to our clinic for any reason 600 maxillary sinus cone beam computed tomography images of the patient were analyzed retrospectively. Maxillary sinus diseases and dental pathologies categoized among themselves.

Results: The age of all patients ranged between 18 and 77 years, with a mean age of 41.38 (±14.39) years. No pathology was detected in 359 (59.8%) of the maxillary sinuses examined which were considered healthy sinuses. The most common pathology in 241 (40.2%) of the maxillary sinuses in the imaging area was mucosal thickening (MT). A statistically significant relationship was detected between teeth with periapical lesions (PL) and MT ($p<0.05$). No statistically significant relationship was found between restorative applications, oro-antral fistula (OAF), periodontal bone loss (PBL), and maxillary sinusitis (MS) ($p<0.05$).

Conclusion: Odontogenic infections and inflammatory events are the causes of maxillary sinus pathologies and may play a role in their formation. CBCT, maxillary posterior teeth and maxillary sinüs in demonstrating the relationship between and in the diagnosis of odontogenous sinus pathlogies is quite useful.

Keywords: Cone beam computed tomography, maxillary sinus, mucosal thickening, periapical lesion, periodontal disease

Öz

Amaç: Maksiller posterior dişlerin kök uçlarının maksiller sinüse yakınlığı, odontojen kaynaklı enfeksiyonun potansiyel bir maksiller sinüzit kaynağı haline gelmesine neden olmaktadır. Bu çalışmanın amacı, diş patolojileri ile maksiller sinüs anormallikleri arasındaki ilişkiyi konik ışınlı bilgisayarlı tomografi (KIBT) kullanarak değerlendirmektir.

Gereç ve Yöntem: Bu çalışmada kliniğimize herhangi bir nedenle başvuran 300 hastanın 600 adet maksiller sinüs konik ışınlı bilgisayarlı tomografi görüntüsü retrospektif olarak incelendi. Maksiller sinüs hastalıkları ve diş patolojileri kendi aralarında kategorize edilir.

Bulgular: Hastaların yaşları 18 ile 77 arasında değişmekte olup ortalama yaş 41,38 (±14,39) olarak tespit edildi. İncelenen maksiller sinüslerin 359'unda (%59,8) patoloji saptanmadı ve sağlıklı sinüs olarak değerlendirildi. Görüntüleme alanındaki maksiller sinüslerin 241'inde (%40,2) en sık görülen patoloji mukozal kalınlaşmaydı (MT). Periapikal lezyonlu dişler (PL) ile MT arasında istatistiksel olarak anlamlı bir ilişki tespit edildi ($p<0.05$). Restoratif uygulamalar, oro-antral fistül (OAF) ve periodontal kemik kaybı (PBL) ile maksiller sinüzit (MS) arasında istatistiksel olarak anlamlı ilişki saptanamadı ($p<0,05$).

Sonuç: Odontojenik enfeksiyonlar ve inflamatuar olaylar maksiller sinüs patolojilerinin oluşumunda rol oynayabilen nedenlerdir. KIBT, maksiller posterior dişler ve maksiller sinüs arasındaki ilişkinin gösterilmesinde ve odontojen sinüs patolojilerinin tanısında oldukça faydalıdır.

Anahtar Kelimler: Konik ışınlı bilgisayarlı tomografi, maksiller sinüs, mukozal kalınlaşma, periapikal lezyon, periodontal hastalık

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INTRODUCTION

Due to the close anatomical relationship of the maxillary sinus floor and maxillary posterior teeth, odontogenic infections affect the sinus mucosa and pathological changes in the maxillary sinus may occur.[1] When the maxillary sinus mucosa is affected by pathogens, pathologies such as mucosal thickening in the sinus, mucus retention cyst, polyp, periostitis and sinusitis may occur.[2] Periapical lesion,[3-5] periodontal bone loss,[6-8] dental caries.[6] poorly performed restorative treatments,[9] endodontic treatment and materials used,[6-8] graft and implant applications[10,11] have been reported as iatrogenic and odontogenic factors that cause changes in the sinus mucosa.

The maxillary sinuses are defined as pneumatic (air-filled) spaces, and cystic, inflammatory, or neoplastic lesions may affect the sinuses.[12] As a result of paranasal sinus inflammation, nasal obstruction, congestion, facial pain, or pressure may occur. A decrease in the sense of smell may occur. Endoscopically, nasal polyps, mucopurulent discharge from the middle meatus, and mucosal obstruction may be observed.[13] Determining the relationship between odontogenic factors and sinus pathologies is essential to ensure the correct diagnosis and treatment planning of the patient. For this, adequate and high-sensitivity diagnostic methods should be preferred.[1]

Radiologically, panoramic and periapical radiographs are helpful in the evaluation of pseudocysts, the degree of pneumatization of the sinüs, and the relationship between the maxillary teeth and the sinus, and in the determination of foreign bodies, roots, or teeth in the sinus.[14] Water's projection provides an ideal visualization of the paranasal sinuses.[15] Magnetic resonance imaging (MRI) is extremely useful in distinguishing between fungal and bacterial infections in the sinonasal region. Bacterial and viral infections cause high signal intensity on T2-weighted[16] images, while fungal infections either cause no signal or show signal intensity similar to air Although computed tomography (CT) is considered the "gold standard" for the examination of the maxillary sinuses, its' use in dentistry has been limited due to the high cost, large footprint and high radiation emission of CT devices. Cone beam computed tomography (CBCT) has played an important role in dentistry, as it contains a lower radiation dose than CT and obtains images in a short time.[1,3,5]

This study aims to evaluate the frequency and localization of maxillary sinus pathologies and their relationship with odontogenic pathologies using CBCT imaging.

MATERIAL AND METHOD

This study was reviewed by the Clinical Research Ethics Committee of Zonguldak Bülent Ecevit University and was decided to be ethically appropriate (2021/12). CBCT images of patients who applied to Zonguldak Bülent Ecevit University Faculty of Dentistry, Department of Oral and Dentomaxillofacial Radiology between 2019-2021 for various reasons were retrospectively analyzed. CBCT images of the patients were obtained by Veraviewepocs 3D R100 / F40 (J Morita Mfg. Corp., Kyoto, Japan) tomography device in our Department of Oral and Dentomaxillofacial Radiology using 90 kVp, 5 mA, and 0.125 mm3 voxel size in 8x10 cm FOV area. CBCT images were evaluated using i-Dixel 2.0 software (J. Morita Corporation, Osaka, Japan).

Image Criteria

CBCT images of patients aged 18 years and older, in which both maxillary sinuses can be distinguished in the same patient. CBCT images of maxillary premolars and molars with any dental pathology were included in the study.

Exclusion Criteria

Patients under the age of 18, patients with a history of trauma, cyst, or tumor formation in the area planned to be examined, and patients who had surgery in the relevant area for any reason were excluded from the study. Incorrect CBCT images that occurred due to device or patient-related reasons during the acquisition of the images were excluded from the study. CBCT images in which the areas planned to be studied and the entire maxillary sinus could not be observed completely were excluded from the study.

Maxillary Sinus Pathologies and Evaluation Criteria

In the radiographic evaluation performed on 1 mm thickness coronal and 0.5 mm thickness axial sections, maxillary sinuses filled with air, in a radiolucent appearance and having clean borders were considered healthy.[17] The position of the teeth was adjusted using a digital protractor instrument so that the long axis of the tooth was parallel to the sagittal plane while measuring. Teeth and sinuses with multiple dental pathologies were not included in the study.

Pathologies in the maxillary sinus; were categorized into four groups; mucosal thickening (MT), maxillary sinusitis (MS), mucus retention cyst (MRC), and polyp. In order not to create a quantitative difference between the groups, the patients were divided into 5 groups according to their age: 18-29 years, 30-39 years, 40-49 years, 50-59 years, and 60 years and above.

Mucosal thickenings of 2 mm or more, well-defined at the base of the maxillary sinus, radiopaque as a strip along the sinus margin, were considered pathological.[18] To detect the presence of mucosal thickening, the distance of the line descended perpendicular to the floor of the maxillary sinus from the end of the mucosal thickening was measured using a digital ruler (**Figure 1**). Peripheral generalized thickening of the maxillary sinus mucosa, increased radiopacity in almost or all of the sinus, and radiolucent air bubbles within the air-fluid level were considered as maxillary sinusitis (**Figure 2**).[19] Mucus retention cysts were defined as low attenuation, well-circumscribed, radiopaque, and dome-shaped expansile soft tissue densities in the maxillary

sinus of varying sizes (**Figure 3**).[20] Sometimes it is difficult to distinguish the radiographic appearance of a mucus retention cyst and an early mucocele. In the presence of bone erosion on CBCT, mucocele should be considered. Round and well-circumscribed masses with soft tissue density and accompanied by thickened adjacent sinus mucosa were defined as polyps (**Figure 4**).[21]

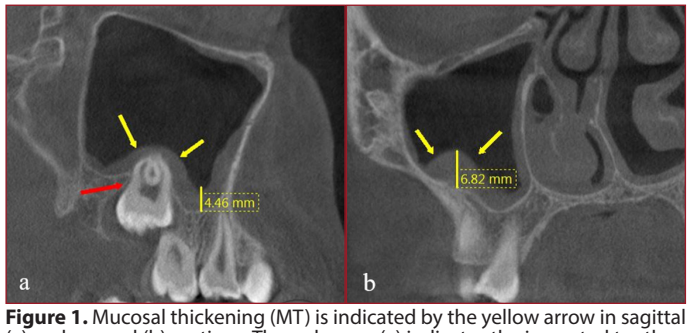

Figure 1. Mucosal thickening (MT) is indicated by the yellow arrow in sagittal (a) and coronal (b) sections. The red arrow (a) indicates the impacted tooth.

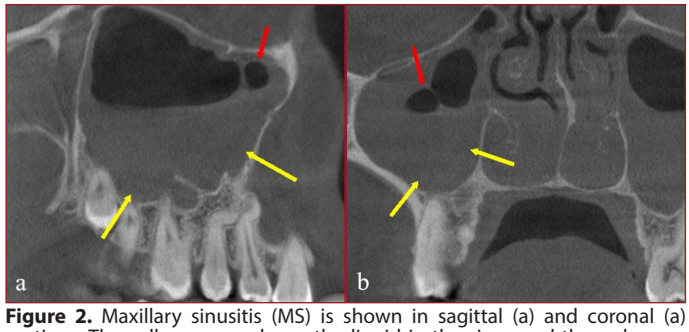

Figure 2. Maxillary sinusitis (MS) is shown in sagittal (a) and coronal (a) sections. The yellow arrow shows the liquid in the sinus and the red arrow shows the air bubbles (a,b).

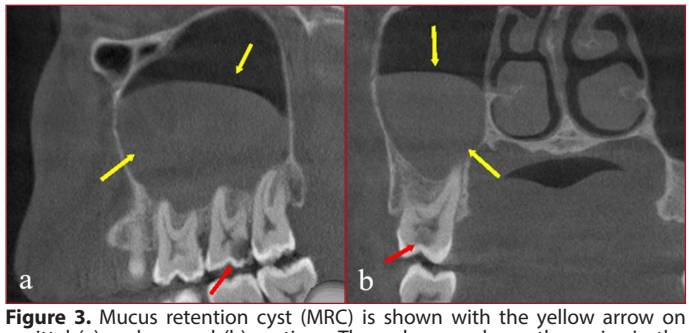

Figure 3. Mucus retention cyst (MRC) is shown with the yellow arrow on sagittal (a) and coronal (b) sections. The red arrow shows the caries in the related tooth (a,b).

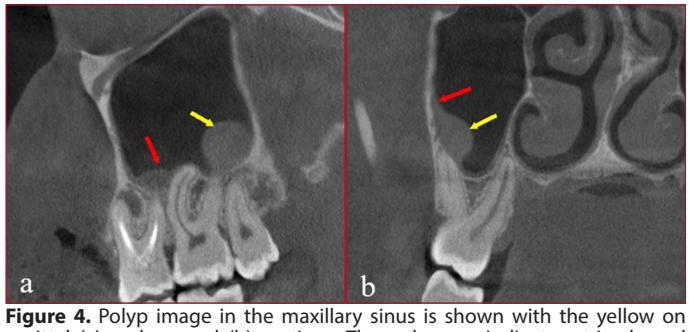

Figure 4. Polyp image in the maxillary sinus is shown with the yellow on sagittal (a) and coronal (b) sections. The red arrow indicates strip-shaped mucosal thickening (a,b).

Radiographic evaluation of odontogenic factors

With the angulation tool in the sections, the position of each tooth, and the long axis of the tooth are adjusted to be parallel with the sagittal plane. All sections including the tooth of interest and the supporting tissues of the tooth were examined. Fixed prosthetic restorations may be observed on teeth due to metal artifact. It was excluded from the study because it may hinder the findings.

In this study, 9 different odontogenic factors were examined. These factors are; it include deep dentin caries (DDC), restorative treatment applications (RTA), root canal treatment (RCT), periodontal bone loss (PBL), periapical lesion (PL), radix, impacted teeth, oro-antral fistula (OAF) and dental implants.

Statistical Analysis

The data obtained from the study were analyzed using the SPSS statistics software (version 20.0, Statistical Package for Social Sciences; IBM, Chicago IL, USA) program. All patient groups included in the study were recorded and data sets were created. Descriptive statistics were made on the data sets, and the distribution of gender and age, and the distribution of pathologies by age and gender were calculated. The relationship between gender, age, odontogenic pathologies, and maxillary sinus pathologies was calculated by applying the "chi-square (x2) test". While evaluating the data, continuous variables were expressed as mean standard deviation (±), and frequency data were expressed as numbers (%). In these tests, the statistical significance level was accepted as $p<0.05$. In the evaluation of maxillary sinus findings and dental pathologies, the Kappa test had an intra-observer agreement of 0.88 and an inter-observer agreement of 0.85. According to these values, the intra-observer and inter-observer agreement was determined to be close to perfect ($p<0.001$).

RESULTS

In this study, 600 maxillary sinus and premolar and molar teeth with dental pathology in the related area were examined in CBCT images of 300 patients. Of the patients, 121 (40.3%) were male and 179 (59.7%) were female. The age of all patients ranged between 18 and 77 years, and the mean age was 41.38 (±14.39). The ages of the female patients ranged between 18 and 69, and the mean age was 39.09 (± 13.40) years. The ages of the males ranged from 18 to 77, with a mean age of 44.77 (± 14.36) years. A total of 933 teeth, 458 in the right upper jaw and 475 in the left upper jaw, associated with any dental pathology were evaluated in the CBCT images examined.

Of all the maxillary sinuses whose CBCT images were evaluated, 359 (59.8%) consisted of healthy sinuses. The most common pathology detected in the remaining 241 (40.2%) maxillary sinuses was MT. 48.5% (117) of all sinus pathologies were seen in men and 51.35% (124) in females. There was no statistically significant difference between sinus pathologies and genders in the study ($p>0.05$) (**Table 1**).

When the age groups of the patients were evaluated, the incidence of healthy sinuses (29.8%) was mostly between the ages of 18-29. Considering the sinus pathologies, the most common age group (24.9%) was between the ages of 40-49. However, when age groups and specific sinus pathologies were evaluated, no significant relationship could be detected (p>0.05). In the study, the most common pathology in all age groups was MT, while MS was most common in the 40-49 age group (**Table 1**).

While there was no statistically significant difference between right and left general maxillary sinus pathologies (p>0.05), 120 (49.8%) of the detected pathologies were in the right maxillary sinus and 121 (50.2%) were in the left maxillary sinus (**Table 1**).

When the relationship between odontogenic factors and maxillary sinus pathology is examined; A statistically significant relationship was found between the presence of DDC in teeth and polyps (p=0.035). A significant correlation was observed between MS (p=0.011) and sinus polyps (p=0.048) and the presence of RTA on teeth. A statistically significant relationship was determined between the presence of PBL and MS (p=0.003), while a statistically significant correlation was stated between teeth with PL and MT (p=0.046). No significant relationship was found between RCT application and any maxillary sinus pathology (p>0.05) (**Table 2**).

In this study, no statistically significant relationship was found between the presence of radix, dental implants, and impacted teeth and maxillary sinus pathologies (p>0.05) (**Table 3**). However, a strong correlation was determined between the presence of OAF and MS (p=0.000) and MT (p=0.005).

Table 1. The relationship between gender, age groups, localization, and maxillary sinus pathologies.

Maxillary Sinus Abnormalities		MT n (%)	p value	MS n (%)	p value	MRC n (%)	p value	Sinus Polyp n (%)	p value
Gender	Male	81 (52.3%)	0.282	23 (46.9%)	0.750	8 (38.1%)	0.362	5 (31,3%)	0.797
	Female	74 (47.7%)		26 (53.1%)		13 (61.9%)		11 (68,7%)	
Age Groups	18-29 years	40 (25.8%)	0.489	7 (14.3%)	0.244	5 (23.8%)	0.791	5 (31.3%)	0.925
	30-39 years	25 (16.1%)		11 (22.4%)		6 (28.6%)		3 (18.8%)	
	40-49 years	36 (23.2%)		17 (34.7%)		4 (19.0%)		3 (18.8%)	
	50-59 years	38 (24.5%)		10 (20.4%)		4 (19.0%)		4 (25.0%)	
	60 years >	16 (10.3%)		4 (8.2%)		2 (9.5%)		1 (6.3%)	
Localization	Right Maxillary Sinus	73 (47.1%)		27 (55.1%)		12 (57.1%)		8 (50.0%)	
	Left Maxillary Sinus	82 (52.9%)		22 (44.9%)		9 (42.9%)		8 (50.0%)	
	Localization p value					0.833			

*MT: mucosal thickening MS: maxillary sinusitis MRC: mucus retention cyst

Table 2. Relationship between odontogenic factors and maxillary sinus anomalies.

Odontogenic Factors	Tooth Type	MT n (%)	p value	MS n (%)	p value	MRC n (%)	p value	Sinus Polyp n (%)	p value
DDC	Premolar Teeth	34 (24.3%)	0.839	8 (5.7%)	0.909	3 (2.1%)	0.854	8 (5.7%)	0.035
	Molar Teeth	55 (39.3%)		21 (15.0%)		6 (4.3%)		5 (3.6%)	
RTA	Premolar Teeth	10 (19.2%)	0.881	2 (3.9%)	0.011	4 (7.7%)	0.283	- -	0.048
	Molar Teeth	22 (42.3%)		8 (15.4%)		5 (9.6%)		1 (1.9%)	
RCT	Premolar Teeth	22 (29.3%)	0.443	13 (17.3%)	0.388	4 (5.3%)	1.000	1 (1.3%)	0.181
	Molar Teeth	22 (29.3%)		6 (8.0%)		1 (1.3%)		6 (8.0%)	
PBL	Premolar Teeth	18 (19.6%)	0.906	9 (9.8%)	0.003	1 (1.1%)	0.642	- -	0.607
	Molar Teeth	39 (42.4%)		19 (20.6%)		3 (3.3%)		3 (3.3%	
PL	Premolar Teeth	22 (44.0%)	0.046	4 (8.0%)	0.854	1 (2.0%)	0.548	- -	-
	Molar Teeth	16 (32.0%)		4 (8.0%)		3 (6.0%)		- -	

*MT: mucosal thickening MS: maxillary sinusitis MRC: mucus retention cyst *DDC: deep dentin caries RTA: restorative treatment applications RCT: root canal treatment *PBL: periodontal bone loss PL: periapical lesions

Table 3. Relationship between odontogenic factors and maxillary sinus anomalies.

Odontogenic Factors	Tooth Type	MK n (%)	p value	MS n (%)	p value	MRK n (%)	p value	Sinus Polyp n (%)	p value
Radix	Premolar Teeth	13 (22.0%)	0.887	6 (10.2%)	0.743	4 (6.8%)	0.284	1 (1.7%)	0.763
	Molar Teeth	25 (42.4%)		7 (11.9%)		2 (3.4%)		1 (1.7%)	
OAF	Premolar Teeth	- -	0.005	- -	0.000	- -	0.309	- -	---
	Molar Teeth	1 (12.5%)		6 (75.0%)		1 (12.5%)		- -	
Impacted Tooth	Premolar Teeth	- -	0.321	- -	0.123	- -	0.572	1 (3.6%)	0.198
	Molar Teeth	15 (53.6%)		6 (21.4%)		2 (7.1%)		4 (14.3%)	
Dental Implants	Premolar Teeth	3 (23.1%)	0.775	2 (15.4%)	1.000	- -	---	- -	---
	Molar Teeth	6 (46.1%)		2 (15.4%)		- -		- -	

*MT: mucosal thickening MS: maxillary sinusitis MRC: mucus retention cyst *OAF: oro-antral fistula

DISCUSSION

Due to the anatomical proximity between the oral cavity and maxillary sinuses, different dental pathologies lead to disruption of the Schneiderian membrane integrity of the maxillary sinus and play a role in the formation of sinus diseases.[5,22] CBCT imaging provides the opportunity to accurately assess the relationship of the maxillary sinuses with adjacent anatomical structures and teeth. While obtaining high-resolution images with CBCT, these images are examined in different planes. CBCT imaging was used in this study due to its high accuracy and sensitivity compared to 2-dimensional radiographs for the detection of maxillary sinus changes. [1,3]

In this study, the relationship between age, gender, and maxillary sinus pathologies was evaluated and the findings were compared with the results of other studies in the literature. Raghav et al.[23] analyzed 402 CBCT images of 201 patients in their study in total, they detected maxillary sinus pathology in 87 (79%) of 110 male patients and 66 (72.5%) of 91 female patients. However, they reported that there was no significant relationship between gender and maxillary sinus pathologies. Ritter et al.[24] included 533 male and 493 female patients in their study. They detected sinus pathology in 326 (60.8%) of male and 253 (51.3%) of female. Ritter et al. reported that no significant relationship was found between gender and a specific maxillary sinus pathology.[24] CBCT images of 121 males and 179 females patients were used in our study. Of all sinus pathologies, 117 (48.5%) were detected in male and 124 (51.5%) in female. Similar to other studies, no significant relationship was stated between gender and maxillary sinus pathologies in this study. Vallo et al. reported that the more common maxillary sinus pathology in male may be because complications resulting from poor oral hygiene are more common in males.[8]

Ritter et al.[24] reported that pathologies are more common in patients aged ≥60 years and that there is a statistically significant relationship only between patients in this age group and maxillary sinus pathologies. Shanbhang et al. obtained similar results in their study and they obtained and reported that MT is seen twice as frequently in male and elderly patients.[5] Contrary to these results, Raghav et al. reported that maxillary sinus pathologies were mostly seen in the 20-29 age group and there was no significant relationship between age groups and sinus pathologies.[23] In our study, maxillary sinus pathologies were mostly seen in the 40-49 age group, but no statistically significant relationship was found between sinus pathologies and age groups.

Considering all sinus pathologies, no statistically significant relationship was found between the right and left maxillary sinuses. In our study, 121 of the sinus pathologies were localized in the left maxillary sinus, while 120 were located in the right maxillary sinus. According to the results of our study, MT (52.9%) was detected more in the left maxillary sinus. Vallo et al.[8] reported that pathologies were more common in the left maxillary sinus. On the other hand, Mahasneh et al.[4] reported that the incidence of MT was higher in the right maxillary sinus and determined that this difference might be the result of septum deviation affected by the presence of concha bullosa. When dental pathologies and other factors are taken into account, it has been reported by studies that an increase in MT may occur in the maxillary sinus. Brulmann et al.[25] reported a positive correlation between carious maxillary posterior teeth and MC. Sheikhi et al.[26] reported that there was an increase in the presence of MT with the presence of teeth with deep caries. As a matter of fact, in our study, no significant relationship was found between DDC and MT ($p>0.05$).

As a result of pulp necrosis, lysosomal enzymes, collagenase, and bacterial agents are released. From the relatively fine-pored maxillary bone, these infectious agents diffuse into the maxillary sinüs. Inflammatory changes in the maxillary sinus mucosa are thought to occur in this way.[15] Mahasneh et al.[4] reported that 54% of teeth with PL caused an increase in MT in the adjacent maxillary sinus, and this rate increased 2.52 times in the presence of PL. Lu et al.[3] reported that the amount of MK was significantly associated with the increase in the size of the periapical lesion and the number of teeth with the periapical lesion. In this study, 933 teeth were evaluated with CBCT, and 70 teeth were found to be associated with PL. Consistent with the results of other studies, a statistically significant relationship was determined between teeth with PL and MT in our study ($p<0.05$).

Phothikhun et al. argued that the thickening of the sinus mucosa is 3 times higher in areas where there is a violent PBL. [7] Similarly, Vallo et al.[8] they stated that furcation problems and periodontal problems caused by different bone losses are associated with MT. Nascimento et al. determined that generalized mucosal thickening was mostly associated with PBL.[1] Phothikhun et al.[7] reported that there was no relationship between root canal fillings and MT. Similarly, Nascimento et al.[1] determined that there was no statistically significant relationship between inadequate endodontic treatment and MT. However, in this study, it was observed that there was no significant relationship between the PBL, RCT, and the MT ($p>0.05$).

Other studies show that odontogenic causes account for 10-12% of MS cases. However, according to recent studies, the prevalence of odontogenic sinusitis reaches 40% with the increasing use of CBCT and CT.[27,28] In this study, the incidence of MS was determined to be 20.3% and the incidence was higher in females. Researchers have reported that many odontogenic conditions can cause MS, including periapical pathology, periodontal diseases, endodontic treatments, dental implants, tooth extraction, trauma, and surgical procedures.[27,28] Lee et al.[29] retrospectively evaluated 27 patients with odontogenic sinusitis, and determined the presence of complications due to dental implants in 10 patients and tooth extraction in 8 patients. Accordingly,

they reported that dental implants and tooth extractions are the most common etiological factors associated with the development of odontogenic MS.[29] Jung et al.[10] placed 23 implants in 9 patients and evaluated sinus complications 6-10 months later and determined no signs of MS in any of the patients. However, they noted that 14 of 23 implants had MC in the sinuses in postoperative CT scans.[10] In this study, there were 13 dental implants included in the image scan and no significant relationship was stated between MS ($p>0.05$). In this study, 8 OAF was detected in 6 patients (75.0%). There are studies showing OAF as the most common cause of odontogenic MS among all dental etiologies. In addition, it should be considered that OAF especially leads to chronic MS cases.[30-32]

In this study, the prevalence of MRC was determined to be 8.7% among maxillary sinus diseases. Yeung et al.[33] reported the incidence of MRC as 20.5% in their studies. Nascimento et al.[1] stated that this rate could vary between 3.6% and 10.1% in CBCT studies involving the Brazilian population. Vallo et al.[8] reported that the incidence of MRC could vary between 5.2% and 14% in their studies using panoramic radiography. It can be thought that these differences in the incidence of MRC may be affected by the type of imaging (2-dimensional or 3-dimensional) or the size of the FOV field applied.

Considering the findings of this study, no significant relationship was found between MRC and any dental pathology or factor ($p>0.05$). Phothikhun et al. also obtained similar results and reported that there was no relationship between PBL, PL and root canal fillings and MRC.7 However, Curi et al.[34] revealed that in the presence of PL and endo-periodontal lesions, it increased 4.1 and 23.8 times in MRC cases. Recent studies have shown that the incidence of maxillary sinus polyp can vary between 6.5% and 19.4%.[29] Nunes et al.[35] evaluated the correlation between PL and sinus polyps and stated that polyps had the highest frequency (23%) after mucosal thickening in maxillary sinus abnormalities due to PL. In our study, the incidence of maxillary sinus polyp was found to be 6.6%. According to the results we obtained, a statistically significant relationship was found between teeth with DDC and RTA and maxillary sinus polyps ($p<0.05$).

CONCLUSION

Many environmental and host factors cause inflammation in the paranasal sinuses. These factors include anatomical variations, odontogenic infections, allergens, and irritants such as smoking. The presence of odontogenic factors should be considered, especially in MS cases that do not improve as a result of conventional treatments.[1,13,29] The most common maxillary sinus pathology in this study was MT. The existence of a relationship between MT, PL and OAF was revealed as a result of the study. In addition, the existence of a relationship between MS and PBL, OAF, and RTA has been observed. Although a relationship was determined between maxillary sinus polyps and DDC and RTA in this study, no relationship was stated between MRC and dental pathologies. In addition, the relationship between dental implants, impacted teeth and the presence of radix and maxillary sinus pathologies was evaluated in this study.

ETHICAL DECLARATIONS

Ethics Committee Approval: This study was reviewed by the Clinical Research Ethics Committee of Zonguldak Bülent Ecevit University and was decided to be ethically appropriate (2021/12).

Informed Consent: Because the study was designed retrospectively, no written informed consent form was obtained from patients.

Referee Evaluation Process: Externally peer-reviewed.

Conflict of Interest Statement: The authors have no conflicts of interest to declare.

Financial Disclosure: The authors declared that this study has received no financial support.

Author Contributions: All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

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Original Article / Orijinal Araştırma

Evaluation of Clinical and Cost Analysis of Patients Applying to the Emergency Service with Extensor Tendon Incision in the Upper Extremity

Üst Ekstremite Ekstansör Tendon Kesisi ile Acil Servise Başvuran Hastaların Klinik ve Maliyet Analizinin Değerlendirilmesi

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Abstract

Aim: Hand trauma is common in emergency departments, with approximately 20% of regional traumas involving hand injuries. Extensor tendon lacerations, often caused by sharp objects, are frequently encountered but may be overlooked, leading to significant morbidity. This study aims to retrospectively review cases of extensor tendon lacerations in the upper extremities to highlight the importance of thorough evaluation and management in the emergency department.

Material and Method: A single-center retrospective study included 114 patients presenting to the emergency department with extensor tendon lacerations. Data on patient demographics, injury characteristics, treatment, complications, and costs were collected and analyzed. Statistical analysis was performed using SPSS version 26.0.

Results: The majority of patients were male adults, with sharp objects such as knives being the most common cause of injury. Extensor tendon repairs were predominantly performed in the emergency department, with complications observed in 14.9% of cases. The mean cost of treatment was $255.97. Factors influencing the decision to perform repair in the operating room included patient age, injury characteristics, and associated injuries.

Conclusion: Extensor tendon lacerations in the upper extremities represent a significant burden in emergency departments. Our findings emphasize the importance of thorough evaluation and timely management to prevent missed diagnoses and optimize patient outcomes. Repairing extensor tendon injuries in the emergency department can be cost-effective and efficient, but careful consideration of patient and injury factors is necessary to determine the most appropriate treatment setting.

Keywords: Cost analysis, extensor tendon incision, upper extremities

Öz

Amaç: El travması acil servislere sık başvuru nedenleri arasındadır. Bölgesel travmaların yaklaşık %20'si el yaralanmalarını içermektedir. Genellikle keskin nesnelerin neden olduğu ekstansör tendon kesileri sık karşılaşılan ancak gözden kaçabilen, ciddi morbiditeye yol açabilen yaralanmalardır. Bu çalışma, acil serviste kapsamlı değerlendirme ve yönetimin önemini vurgulamak için üst ekstremitelerdeki ekstansör tendon kesisi vakalarını retrospektif olarak gözden geçirmeyi amaçlamaktadır.

Gereç ve Yöntem: Ekstansör tendon kesisi nedeniyle acil servise başvuran 114 hasta tek merkezli retrospektif olarak çalışmaya dahil edildi. Hasta demografisi, yaralanma özellikleri, tedavi, komplikasyonlar ve maliyetlere ilişkin veriler toplandı ve analiz edildi. İstatistiksel analiz SPSS 26.0 versiyonu kullanılarak yapıldı.

Bulgular: Hastaların çoğunluğu yetişkin erkekti ve yaralanmaların en yaygın nedeni bıçak gibi keskin nesnelerdi. Ekstansör tendon onarımları ağırlıklı olarak acil serviste yapıldı ve vakaların %14,9'unda komplikasyon görüldü. Ortalama tedavi maliyeti 255,97 dolardı. Ameliyathanede onarım yapma kararını etkileyen faktörler arasında hastanın yaşı, yaralanma özellikleri ve ilişkili yaralanmalar yer alıyordu.

Sonuç: Üst ekstremitedeki ekstansör tendon kesileri acil servislerde önemli bir yük oluşturmaktadır. Bulgularımız, gözden kaçan tanıları önlemek ve hasta sonuçlarını optimize etmek için kapsamlı değerlendirme ve zamanında yönetimin önemini vurgulamaktadır. Acil serviste ekstansör tendon yaralanmalarının onarılması uygun maliyetli ve verimli olabilir, ancak en uygun tedavi ortamının belirlenmesi için hasta ve yaralanma faktörlerinin dikkatli bir şekilde değerlendirilmesi gereklidir.

Anahtar Kelimeler: Maliyet analizi, ekstansör tendon kesisi, üst ekstremite

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INTRODUCTION

Hands are highly vulnerable to trauma in our daily lives and can be easily traumatized. Emergency department visits with hand trauma constitute approximately 20% of all regional traumas.[1,2] In a study conducted in the literature with hand trauma cases, it was reported that approximately 82% of the cases had soft tissue injuries.[3] In another literature study, in a series of 50 272 hand injury cases, 35% of the injuries were simple injuries, and 5% of the same cases had tendon injuries.[4]

It has been reported that the most common etiology of hand injuries is sharps injuries.[3-5] In the literature, it has been reported that the most common sharp-piercing instruments used in hand injuries are knives and glass, while the fingers are the most commonly injured part of the hand.[3,4]

There are many epidemiologic studies on hand injuries in the literature. However, few studies in the literature draw attention to the level of deep structures being affected or overlooked, even in tiny incisions in the emergency department. The most common reason for missing deep injuries despite a small incision area is the lack of adequate examination. In such injuries, the observer makes a quick decision due to the small size of the injury and does not make the necessary assessment.[6] Although these injuries are not life-threatening, they can lead to severe morbidities. These types of injuries deserve the necessary attention due to the complexity of the hand structure and the long rehabilitation process in these patients. Therefore, we should make the necessary evaluation and elaborate the examination of deep lacerations in the upper extremities, especially in the hand and wrist.

In this study, we aimed to conduct a retrospective review of patients admitted to the emergency department with lacerations of the extensor tendons in the upper extremities and draw attention to extensor tendon lacerations in the emergency department.

MATERIAL AND METHOD

Study Design and Setting

Our study is a single-center and retrospective study. Our hospital is one of the largest tertiary care hospitals in the region, with 1400 daily emergency department visits, and all critical interventions can be performed.

An emergency medicine specialist and an orthopedic specialist conducted our study. Our study was performed according to the review guidelines for retrospective studies in emergency medicine summarized by Kaji et al.[7]

Patient Selection

Our study was performed on patients who presented to the emergency department with upper extremity trauma and were found to have extensor tendon lacerations after evaluation. Routine treatment and follow-up were performed immediately after admission.

The study included 114 patients. Patients with incomplete data, patients who were not considered to have extensor tendon laceration, patients who had repeated admissions to our centers, and patients with total or partial limb amputation were excluded from the study.

Ethics committee approval was obtained from the Clinical Ethics Committee of our 3rd Level Training and Research Hospital (dated 10/08/2021 with the Ethics Committee No. KAEK/2021.05.88), and the study was started.

Data Sources

Our study scanned the database of our hospital's automation system and patient files to identify the cases. ICD codes "S66, S66.2, S66.3, S66.4, S66.5, S66.7, S66.8, S69.7, S69.8, and S69.9" were used for the extensor tendon of the upper extremity. Only the first admissions of patients with repeated admissions were included among the patients included in the study.

Data Collection

A study data form was created to collect and standardize the data in our study. This form systematized data collection and facilitated the identification of cases with missing data.

In our study, 114 patients who presented to the emergency department with upper extremity trauma between 01/01/2022 and 01/01/2023 with extensor tendon incision were included. The etiology of trauma, the time elapsed between the onset of trauma and admission, the name and localization of the extensor tendons, whether the incision was partial or complete, the place of intervention (emergency department or operating room), complications, and cost analysis parameters were examined and recorded in the previously created study data form.

In our study, emergency and orthopedic specialists with at least three years of experience in the field evaluated extensor tendon incisions.

Loss of flexion due to extensor tendon contraction after repair, loss of flexion and extension due to adhesions, and weakened grip in the patients were considered complications.

Outcome Measures

The primary outcome of our study was to draw attention to extensor tendon laceration, which can be seen in patients presenting to the emergency department with upper extremity trauma. As a secondary outcome, we aimed to evaluate the follow-up, complications, and costs in cases with extensor tendon incisions and to contribute to the literature with our results.

Statistical Analysis

Data were analyzed with SPSS Package Program version 26.0. Number, percentage, mean, standard deviation, median, minimum, maximum, median, minimum, and maximum were used to present descriptive data. The Kolmogorov-

Smirnov Test evaluated the suitability of the data for using thermal distribution. In univariate analysis, median (IQR) values were given for continuous variables not showing normal distribution, and mean (±standard deviation) values were given for continuous variables showing normal distribution. Pearson Chi-Square Test was used to analyze categorical variables. Fisher's Exact Test was used in the presence of less than five variables in categorical variables. The T-test was used to compare two independent numerical data.

$p<0.05$ was accepted as the level of statistical significance.

RESULTS

Of the 114 patients in our study, 55.3% were male, and the mean age was 33.46±11.70 years. 11.4% of the patients were children, and 88.6% were adults. The most common mechanism of injury was sharps injury, with a rate of 75.4%, and the most common object causing injury was a knife (49.1%) . The patients presented to the emergency department after a mean of 2.43±1.72 hours of trauma. It was seen that the most common extremity direction of trauma was right (55.3%), the most common injury site was the metacarpal region with 36.0% (n=41), and the mean wound size was 3.00±1.70 cm. It was learned that 20.2% of the cases were injured due to work accidents. While 74.6% of these cases had complete (total) tendon laceration, 25.4% had incomplete (partial) tendon laceration. The bone fracture was associated with tendon incision in 12.3% of these cases; nerve injury was associated with tendon incision in 7.9%, and arterial injury in 13.2%. Tendon repair was performed in the emergency department in 67.5% of the cases, while in 32.5%, the repair was planned in the operating room. Complications were seen in 14.9% of cases. The mean cost of the cases was $255.97±83.50 (**Table 1**).

It was questioned whether the injured extremity was dominant or not. It was seen that 53.6% (n=61) of these patients had a dominant hand injury.

Posttraumatic evaluation of the patients was performed, and then trauma-directed treatment was planned. Among these patients, repair was planned in the operating room because pediatric patients were noncompliant with the physician during repair (p=0.022), the injury area was not suitable for evaluation and repair in the emergency department in patients with a long admission time after injury (p=0.024), patients with high injury size (p=0.030), and patients with forearm injuries required additional dissection to find tendon ends and had additional injuries (p=0.016). In addition, repair was performed in the emergency department in partial tendon incisions because it was more feasible. After all, the tendon ends could be seen (p=0.043). However, in addition to all these factors, the cost of tendon repair in the operating room was significantly higher than in the emergency department (**Table 2**).

Table 1 Evaluation of demographic and clinical data of the patients

Parameter	n (%) / Mean±SD
Age (years)	33.46±11.70
Gender	
Woman	51 (44.7)
Male	63 (55.3)
Age Group	
Child	13 (11.4)
Adult	101 (88.6)
Direction of Injured Extremity	
Right	63 (55.3)
Left	51 (44.7)
Time between injury and application (hours)	2.43±1.72
Injury Mechanism	
Sharps Injury	86 (75.4)
Blunt Trauma	28 (24.6)
Wound Size (cm)	3.00±1.70
Type of Injury	
Blunt Trauma	28 (24.6)
Knife Cut	56 (49.1)
Glass Cut	24 (21.1)
Other	6 (5.3)
Injury Localization	
Finger	29 (25.4)
metacarpal	41 (36.0)
Wrist	14 (12.3)
forearm	30 (26.3)
Work accident situation	
None	91 (79.8)
There is	23 (20.2)
Tendon Incision Type	
Complete /Total	85 (74.6)
Incomplete / Partial	29 (25.4)
Place of intervention	
Emergency room	77 (67.5)
Operating room	37 (32.5)
Additional Injury	
None	76 (66.7)
Bone Fracture	14 (12.3)
Nerve Injury	9 (7.9)
Artery Injury	15 (13.2)
Complication	
None	97 (85.1)
There is	17 (14.9)
Cost ($)	255.97±83.50

Table 2 Examination of the factors affecting whether the cases were repaired in the emergency department or in the operating room

Parameter	Place of intervention		p
	Emergency Department (n=77) n (%) / Mean±SD	Operating room (n=37) n (%) / Mean±SD	
Age (years)	33.54±11.52	33.26±1.52	0.466
Gender			
Woman	38 (74.5)	13 (25.5)	0.278
Male	41 (65.1)	22 (34.9)	
Age Group			
Child	5 (38.5)	8 (61.5)	0.022
Adult	72 (71.3)	29 (28.7)	
Direction of Injured Extremity			
Right	46 (73.0)	17 (27.0)	0.339
Left	33 (64.7)	18 (35.3)	
Time between injury and application (hours)	2.19±1.25	2.97±2.41	0.024
Injury Mechanism			
Sharps Injury	60 (69.8)	26 (30.2)	0.849
Blunt Trauma	19 (67.9)	9 (32.1)	
Wound Size (cm)	2.77±1.60	3.49±1.88	0.030
Type of Injury			
Blunt Trauma	19 (67.9)	9 (32.1)	0.701
Knife Cut	40 (71.4)	16 (28.6)	
Glass Cut	17 (70.8)	7 (29.2)	
Other	3 (50.0)	3 (50.0)	
Injury Localization			
Finger	25 (32.5)	4 (10.8)	0.001
metacarpal	32 (41.6)	9 (24.3)	
Wrist	6 (7.8)	8 (24.3)	
forearm	14 (18.2)	16 (43.2)	
Work accident situation			
None	65 (71.4)	26 (28.6)	0.327
There is	14 (60.9)	9 (39.1)	
Tendon Incision Type			
Complete /Total	53 (62.4)	32 (37.6)	0.043
Incomplete / Partial	24 (82.8)	5 (17.2)	
Additional Injury			
None	58 (76.3)	18 (48.6)	0.016
Bone Fracture	7 (9.1)	7 (18.9)	
Nerve Injury	4 (5.2)	5 (13.5)	
Artery Injury	8 (10.4)	7 (18.9)	
Complication			
None	69 (71.1)	28 (28.9)	0.310
There is	10 (58.8)	7 (41.2)	
Cost ($)	212.87±47.80	353.26±62.23	<0.001

DISCUSSION

Deep injuries in the upper extremities are often overlooked and may cause significant morbidity and loss of function in these cases. Although clinical evaluations and diagnostic information regarding tendon and other soft tissue (nerve, vessel, etc.) injuries are frequently described in the literature, many tendon injuries are still overlooked.[8,9] In addition, the clinician frequently overlooks arterial injuries due to the double arterial blood supply to the forearm and hand.

In our study, 11.4% of the cases were pediatric patients under the age of 18 years. It was observed that extensor tendon injuries in these patients were repaired in the operating room at a higher rate due to their incompatibility with the physician and agitation during repair. A comparison could not be made because of the need for similar study data.

When the gender distribution of patients with extensor tendon incision was analyzed, it was found that male patients were more common. Broback et al. found a male gender preponderance in their study.[10] In the study by Angermann and Lohmann, the male/female ratio was 2/1.[5] In our study, this ratio was significantly lower than in the literature. We think that this is because many patients were referred to our hospital from the surrounding regions, and these regions are primarily rural areas; women are exposed to injuries as much as men because they are doing active daily work (cooking, cutting wood, pruning, etc.).

There is a consensus in the literature that injuries occur equally in the dominant or non-dominant hand.[11-14] In our study, the approximately equal incidence of injury in the dominant and non-dominant hand was similar to the literature.

Although there are many different types of injuries, the literature has reported that the highest rate of injuries is with glass.[3,5] In addition, Singer and Maloon reported that the most common injury was with a knife.[15] Our study observed that the most common injury was with a knife, as in the study of Singer and Maloon. We think that this is again due to the high proportion of women in our study and the high risk of knife injuries in daily housework.

Singer and Maloon reported that proximal finger level was the most common extensor tendon injury.[3-5,15] In a similar study, it was reported that the most common extensor tendon injury was at the level of the proximal and middle finger joints and that there were approximately equal injuries in these two regions. Turker et al. reported that the most common extensor tendon injury was in the metacarpal region.[16] Similarly, Meyer et al. reported that extensor tendon injuries were most common in the metacarpal region.[17] Our study observed the highest injury rate in the metacarpal region. The extensor tendons in the metacarpal region are more superficial and frequently exposed to injuries.

In our study, extensor tendon repairs were performed in the emergency department in 67.5% of the cases. This situation has some advantages and disadvantages.[18,19] Repair in the emergency department is advantageous for rapid treatment

and discharge. In addition, it will not cause unnecessary surgical preparation and operating room intensity for patients. On the other hand, it will cause overcrowding in the emergency department, which is a disadvantage. In addition, it is seen that repair in the emergency room is more cost-effective than repair in the operating room. As far as we know, there are no similar studies in the literature on this subject, and our study is pioneering in cost analysis.

Limitations of Study

The first limitation of the study was the difference in the number of pediatric and adult patients since randomized patients were included. In addition, patients with extensor tendon incisions diagnosed with different ICD 10 codes were not included in the study. However, our study results will not show significant variability due to these limitations.

CONCLUSION

We presented general information about extensor tendon incisions in patients admitted to the emergency department with upper extremity trauma and wanted to draw attention to this issue. In these cases, a detailed examination of the patient for extensor tendon incision will prevent the tendon incision from being missed. In addition, improving the conditions in the emergency department regarding tendon repairs will prevent unnecessary operating room intensity and reduce costs.

ETHICAL DECLARATIONS

Ethics Committee Approval: Ethics committee approval was obtained from the Clinical Ethics Committee of our 3rd Level Training and Research Hospital (dated 10/08/2021 with the Ethics Committee No. KAEK/2021.05.88), and the study was started.

Informed Consent: Because the study was designed retrospectively, no written informed consent form was obtained from patients.

Referee Evaluation Process: Externally peer-reviewed.

Conflict of Interest Statement: The authors have no conflicts of interest to declare.

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Author Contributions: All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

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Case Report / Olgu sunumu

Copy Number Alterations Associated with Schinzel-Giedion Syndrome: Case Report

Schinzel-Giedion Sendromu ile İlişkili Kopya Sayısı Değişiklikleri: Olgu Sunumu

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Abstract

Schinzel-Giedion syndrome (SGS) is a highly recognizable syndrome characterized by severe mental retardation, distinctive facial features, multiple congenital malformations, and higher-level neurological deficits. Comprehending SGS is essential for customized medical treatment, genetic counseling, and furthering developmental problem research. Enhanced understanding leads to better assistance for impacted people and their families, which improves results overall. In this study, we present a case of SGS associated with 2q35-q37 duplication, 4q34.1 duplication, and 9p24.3-24.1 deletion.

Keywords: Schinzel-Giedion syndrome, case report, 2q35-q37 duplication, 4q34.1 duplication, 9p24.3-24.1 deletion

Öz

Schinzel-Giedion syndrome (SGS) is a highly recognizable syndrome characterized by severe mental retardation, distinctive facial features, multiple congenital malformations, and higher-level neurological deficits. Comprehending SGS is essential for customized medical treatment, genetic counseling, and furthering developmental problem research. Enhanced understanding leads to better assistance for impacted people and their families, which improves results overall. In this study, we present a case of SGS associated with 2q35-q37 duplication, 4q34.1 duplication, and 9p24.3-24.1 deletion.

Anahtar Kelimeler: SGS, olgu sunumu, 2q35-q37 duplikasyonu, 4q34.1 duplikasyonu, 9p24.3-24.1 delesyonu

INTRODUCTION

Schinzel-Giedion syndrome (SGS) was initially identified by Schinzel and Giedion. Severe mental retardation, characteristic facial features, multiple congenital malformations (such as skeletal abnormalities, genitourinary and renal malformations, and heart defects), and higher-order neurological deficits are the hallmarks of this highly identifiable syndrome.[1]

Another account cited a tiny, tilted nose, macroglossia, a short neck, a large and wide forehead, enormous fontanelles, ocular hypertelorism, and bilateral hydronephrosis. Anomalies include aberrant fundus, cerebral ventricle enlargement, splenopancreatic fusion, enlarged and dense long bone cortices, and heart problems.[2]

The facial phenotype, which includes the broad forehead, retraction of the midface, and tiny, turned-up nose, together with one of two additional key differentiators (typical skeletal abnormalities or hydronephrosis), can be used to make a clinical diagnosis. Broad ribs, significant supraoccipital-exoccipital synchondrosis, sclerotic skull bases, and increased cortical density or thickness are examples of common skeletal deformities. Hypertrichosis, brain abnormalities, and neuroepithelial cancers (17%) are further strongly supporting characteristics. Among the cases that have been recorded, severe developmental delay and poor survival are constants.[2]

The same clinical findings, including megacalycosis, progressive neurodegeneration with infantile spasms, and

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hypsarrhythmic activity, were reported in two infants. Together with ocular hypoesthesia, tuning fork malformation of the stirrup bone, and alacrimia. These characteristics might help define SGS as an additional clinical criterion in the future.[3]

Research has indicated that the duplication of 2q35-q37 has been linked to several conditions such as growth failure, dysmorphic findings, cardiovascular abnormalities, genitourinary system anomalies, and global developmental delay.[4] Global developmental delay, complete/partial gonadal dysgenesis, and autistic spectrum disease have all been linked to the 9p24.3 deletion.[5] Furthermore, renal hypoplasia, microcephaly, growth retardation, epilepsy, and dysmorphic features have all been linked to 4q duplication.[6]

CASE REPORT

The male patient was 2 years old when he applied to Umraniye Training and Research Hospital in Istanbul. His seizures began at 4.5 months old, and he has both epilepsy and a developmental disability. Two months before being admitted to the hospital, he suffered his final seizure. At 34 weeks gestation, he was born as G2Y2 and weighed 3740 grams. Due to his respiratory discomfort and feeding issues, he spent a month in the incubator. The mother and father are not consanguineous.

Necrotizing enterocolitis was identified at admission and optic disc hypoplasia in the left eye was found during the newborn eye examination. After doing an echocardiography, atrial septal defect (ASD) was diagnosed. The karyotype is 46, XY. The arachnoid space expanded. Frontal atrophy was taken into consideration (**Figure 1**). SGS was identified by the genetics department's findings. Molecular karyotyping revealed the presence of 2qdup-9pdel. The size of the head measured 45.5 cm. In addition to having severe hypotonia in the axial and extremities, he was dysmorphic and lacked head control. There was simply seeking eye movements and no eye tracking.

Chewing was absent, as well as assisted sitting. Meals must be consumed in puree form for him. He was seen to be seizure-free. A left ear issue was discovered during a hearing test, but it was not investigated. The results of an array study at an external facility showed deletion at 9p24.3-24.1, duplication at 2q35q37, duplication at 4q34.1, and partial trisomy. On chromosome 9, a heterochromatin region was found by karyotype analysis. The results of the karyotype studies for the mother and father were normal. His sibling is in good health, and his karyotype is similarly determined to be normal.

His height was 84 cm, head circumference was 46.5 cm, and his body weight was 9,770 g during his subsequent examination. Gray sclera and hypertelorism were determined to be positive. The hands were little, the upper lip was slender, and the philtrum was lengthy. The bilateral fifth fingers showed signs of clinodactyly and hypospadias, and the scrotum was unable to palpate either testicle.

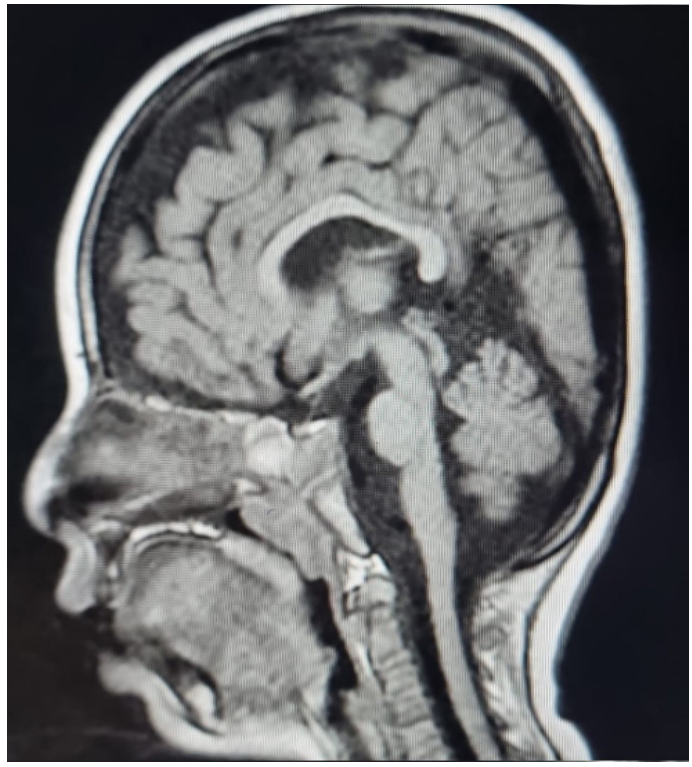

Figure 1. MRI image showed that the arachnoid space was enlarged in the bilateral frontotemporal parietal region.

Both testicles in the scrotal USG were of normal size. The inguinal canal revealed both testicles. The glandular prepuce was missing, and the penis was slightly twisted on the right. The size of each epididymis was normal. Each testicle's echo structure was uniform. Both the waking and sleep electroencephalogram showed widespread epileptiform abnormality.

DISCUSSION

Our case presents a compelling array of challenges, encompassing various malformations affecting the limbs, urogenital system, and facial features. Beyond the evident physical anomalies such as a large philtrum, hypertelorism, and other facial characteristics, our patient also exhibited a spectrum of concerning symptoms including visual and auditory impairments, growth retardation, and muscle hypotonia. These phenotypic abnormalities have been strongly associated with the duplication of the 2q35-q37 region, a significant finding that underscores the complexity of our case.[7]

Furthermore, the implications extend beyond mere physical abnormalities. Heart abnormalities, an issue of critical concern, have also been linked to the duplication of the 2q33-q37 region. Remarkably, our case exhibited a duplication in the 2q35-q37 region, suggesting a potential association with ASD, a condition demanding urgent attention and specialized care.

Epilepsy and neurodevelopmental delay are distressingly common among patients with similar genetic duplications, categorizing our case within the spectrum of epileptic and developmental encephalopathies.[9] The onset of epileptic seizures in our patient aligns with prior studies correlating seizures with specific genetic duplications, such as the 4q34.1 duplication.[4] Notably, our patient began experiencing seizures at a young age, emphasizing the urgency of intervention and comprehensive care.

Compounding these challenges, our patient's MRI scans revealed frontal brain atrophy, mirroring observations from previous studies,[9] and highlighting the progressive nature of the condition. These neurological manifestations underscore the critical need for ongoing monitoring and intervention to mitigate potential complications and optimize outcomes.

Additionally, our patient exhibited a constellation of symptoms reminiscent of monosomy 9p syndrome, further complicating the diagnostic landscape. The presence of developmental delays, craniofacial abnormalities, and cardiac issues aligns with the characteristic features of this syndrome, necessitating a holistic approach to management.

CONCLUSION

Our case presents a compelling narrative of complex genetic anomalies with profound implications for both physical and neurological health. By elucidating the intricate interplay between genetic duplications and clinical manifestations, our findings underscore the pressing need for multidisciplinary intervention and ongoing research to enhance our understanding and management of such conditions.

ETHICAL DECLARATIONS

Informed Consent: All patients signed the free and informed consent form.

Referee Evaluation Process: Externally peer-reviewed.

Conflict of Interest Statement: The authors have no conflicts of interest to declare.

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