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Original Article

Not All Corridors are Equal: Corridor Length Affects 6-minute Walk Test Performance–A Randomized Crossover Trial

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ABSTRACT

OBJECTIVE: The recommended corridor length for the 6-minute walk test (6MWT) is 30 meters. However, it is not always feasible in clinical practice. The objective of this study was to compare walking distance and hemodynamic responses during 6MWTs performed in 10-, 20-, and 30-meter corridors in healthy young adults.

MATERIAL AND METHODS: Thirty-four healthy young adults (mean age: 21.2±1.5 years; female/male: 25/9) completed three randomized 6MWTs in 10-, 20-, and 30-meter corridors on separate days and with a crossover design. Walking distance, mean walking speed, and step counts were measured. Heart rate, blood pressure, respiratory rate, peripheral oxygen saturation, dyspnea, and fatigue were recorded at baseline (Pre), immediately post-test (Post), and at 3 (R3) and 5 (R5) minutes of recovery. Data were analyzed using the Friedman test with post-hoc Wilcoxon signed-rank tests and Bonferroni correction.

RESULTS: Walking distance and speed were significantly lower in the 10-meter corridor than in the 20- and 30-meter corridors ($P < 0.05$), whereas step counts did not differ ($P = 0.065$). Hemodynamic responses were similar in all tests, except for increased post-test fatigue and dyspnea at R5 during the 10-meter corridor test ($P < 0.05$).

CONCLUSION: Although hemodynamic responses were comparable across different corridor lengths, the 10-meter corridor led to an underestimation of walking distance by ~60 meters and to increased subjective fatigue and dyspnea. A 20-meter corridor may serve as a feasible alternative when the standard 30-meter corridor is unavailable in clinical practice, whereas a 10-meter corridor should be avoided.

KEYWORDS: 6-minute walk test, walking distance, corridor length, exercise testing

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INTRODUCTION

The 6-minute walk test (6MWT) is one of the most widely used field tests to evaluate functional exercise capacity in various populations. Its simplicity, reproducibility, and ability to reflect the integrated responses of the musculoskeletal and cardiopulmonary systems have made it a popular tool in both clinical and research settings.[1] The walking distance is the primary outcome in 6MWT, which asks the patient to walk as far as they can along a 30-meter corridor in six minutes.[2] Reference equations incorporating variables such as age, gender, height, and weight have been established to interpret test results.[3-5] Functional capacity is then assessed based on the percentage of predicted values achieved.

The American Thoracic Society (ATS) and the European Respiratory Society (ERS) guidelines state that the 6MWT should be performed in a 30-meter corridor.[2] However, in clinical practice, environmental and spatial constraints often necessitate using shorter corridors. This limitation has prompted several investigations into whether corridor length affects test performance. Previous studies, mostly conducted in patient populations such as individuals with stroke or chronic respiratory diseases, have suggested that shorter corridor lengths may alter test outcomes.[6-10]

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Despite this evidence, the majority of research has focused on clinical populations, and data on the influence of corridor length on 6MWT performance in healthy individuals remain limited. In a current study, Chuatrakoon et al.[11] revealed that <20-meter corridors varied results compared to the standard length, and a walkway of >15 meter had a very strong agreement with a standard walkway. Understanding these effects in healthy young adults is important to establish baseline evidence and to inform clinical interpretation. The present study aimed to compare 6MWT performance and hemodynamic responses in healthy young adults across 10-, 20-, and 30-meter corridors. We hypothesized that a 10-meter corridor would lead to earlier onset of fatigue, more rapid increases in vital signs, and shorter walking distances.

MATERIAL AND METHODS

Participants and Pre-test Assessments

The study was conducted at the Research, Education, and Innovation Laboratories of the Department of Physiotherapy and Rehabilitation, İzmir Katip Çelebi University. An a priori sample size calculation was performed using G*Power V3.1.9.7. With an effect size of 0.25, a 95% confidence interval, and a 5% margin of error, a minimum of 33 participants was required.[12] Anticipating a 20% dropout, 40 participants were initially recruited. Ultimately, 34 participants completed all stages of the study (Figure 1).

Eligible participants were between 18 and 25 years of age, and we excluded participants who had chronic diseases diagnosed by a physician, were receiving regular medical treatment, and had physical limitations that could impair walking ability. Demographic characteristics, including age, sex, height, weight, and smoking status, were recorded. Before testing, all participants rested for 10 minutes, and their baseline hemodynamic parameters were assessed.

Test Procedures

This study was conducted using a randomized crossover design and was completed in accordance with the CONSORT Extension for Crossover Trials checklist. Each participant completed the 6MWT on three occasions following a familiarization session, once at each corridor length (10, 20, and 30 meters), with the order randomized, using computer-generated sequences, by a blinded physiotherapist who assessed the participants. The ATS guidelines were followed for the familiarization session. In this session, we explained the task, had the participant walk alone at their own pace for 6 minutes, and used the standardized encouragement script on a separate day.[2] Tests were scheduled on separate days between 08:00 a.m. and 12:00 p.m. to minimize circadian variability, and the order of tests was randomized to reduce potential learning effects.

Main Points

- The 6-minute walk test (6MWT) is an important tool fto assess exercise capacity.
- In conditions where a 30-meter corridor is not available, a 20-meter corridor may be sufficient for a 6MWT.
- The results of a 6MWT conducted in a 10-meter corridor will differ from those of a 20- and 30-meter corridor.

A one-day break was given between the three tests. Participants were instructed to avoid activities that would cause excessive fatigue and to abstain from heavy alcohol consumption or supplement use during this period. Participants were excluded if they were fasting, had eaten immediately before testing, had engaged in strenuous exercise within the 24 hours prior to testing, had smoked, or had used medications/supplements that might influence performance.

Every test was conducted in a calm, indoor corridor with a level, straight floor and markings spaced three meters apart. The turning points were indicated with two cones. Participants were instructed to walk as far as possible for six minutes at their own pace. Standardized encouragement was provided at one-minute intervals, consistent with ATS/ERS guidelines.[2,13]

Outcome Measures

The primary outcome was walking distance. Secondary outcomes included mean walking speed, step count, heart rate, systolic and diastolic blood pressure, respiratory rate, peripheral oxygen saturation (SpO_2), dyspnea, and fatigue. Walking distance, speed, and step counts were recorded using a smartwatch (Fitbit Charge 5, United States). Predicted walking distance was calculated according to Cazzoletti et al.'s[14] formula, considering age, sex, height, and values of the participants. In addition, the percentage of the predicted maximum heart rate according to Tanaka et al.[15] was recorded for each participant. Dyspnea and fatigue were evaluated using a visual analogue scale (0–100) because it is a sensitive and reproducible tool.[16,17] Hemodynamic variables were assessed at four time points: pre-test (Pre), immediately post-test (Post), 3 minutes into recovery (R3), and 5 minutes into recovery (R5).

Ethical Considerations

The entire study process was conducted in accordance with the principles of the Declaration of Helsinki. Ethical approval was obtained from the İzmir Katip Çelebi University Non-Interventional Research Ethics Committee (approval no: 382, date: 22.09.2022, 2024/08/05). All study details were explained to all participants, and written informed consent was obtained.

Statistical Analysis

The data obtained from the research were analyzed using the SPSS 22.0 statistical software package. Descriptive data are presented as mean ± standard deviation for normally distributed continuous variables, median (25/75 interquartile range) for non-normally distributed continuous variables, and percentage (%) for categorical variables. The walking distance was defined as the primary outcome measure. The Friedman test was used to compare the effects of the test corridors on outcomes. If significant differences were found, the Wilcoxon signed-rank test with Bonferroni correction was applied for pairwise comparisons.

Intraclass correlation coefficient (ICC) analysis with a two-way mixed-effects model was performed to examine the reliability of the test across three conditions. ICC values were interpreted as follows: <0.50, poor; 0.50–0.75, moderate; 0.75–0.90, good; and >0.90, excellent reliability. Effect sizes for the Friedman test were expressed as Kendall's coefficient of concordance (Kendall's W). Kendall's W values of 0.10, 0.30, and 0.50 were interpreted as small, moderate, and large effects, respectively.

RESULTS

Participant Characteristics

A total of 34 participants who met the study's inclusion criteria were enrolled (Figure 1). Six participants did not complete all tests. Descriptive characteristics are presented in Table 1. Most participants were female, non-smokers, and had body mass index within the normal range. Mean age was 21.2±1.5 years.

Hemodynamic and Symptom Responses

Pre-test values for heart rate, blood pressure, respiratory rate, SpO_2, dyspnea, and fatigue did not differ significantly across the three test conditions ($P > 0.05$). Post-test and R3 values were also comparable across corridor lengths, except for fatigue, which was significantly higher following the 10-meter 6MWT than after the 20- and 30-meter corridors ($P = 0.048$). At R5, dyspnea was significantly greater after the 10-meter corridor than after the 20-meter corridor ($P = 0.029$), while all other parameters remained similar (Table 2).

Walking Performance

Walking distance differed significantly across the three corridor lengths ($P < 0.001$). Pairwise comparisons indicated that distances achieved in the 10-meter corridor were significantly shorter than those in the 20- and 30-meter corridors (both $P < 0.001$), whereas no difference was observed between the 20- and 30-meter corridors (Figure 2). On average, the walking distance in the 10-meter corridor was approximately 60 meters shorter than in the longer corridors.

Step counts did not differ significantly among conditions ($P = 0.065$). Walking speed, however, was considerably lower in the 10-meter corridor than in the 20-meter corridor ($P = 0.033$), whereas no difference was found between the 20- and 30-meter corridors (Table 3). Additionally, the percentage of predicted walking distance was lower and the percentage of maximum heart rate was higher during the 6MWT performed in a 10-meter corridor (Table 3).

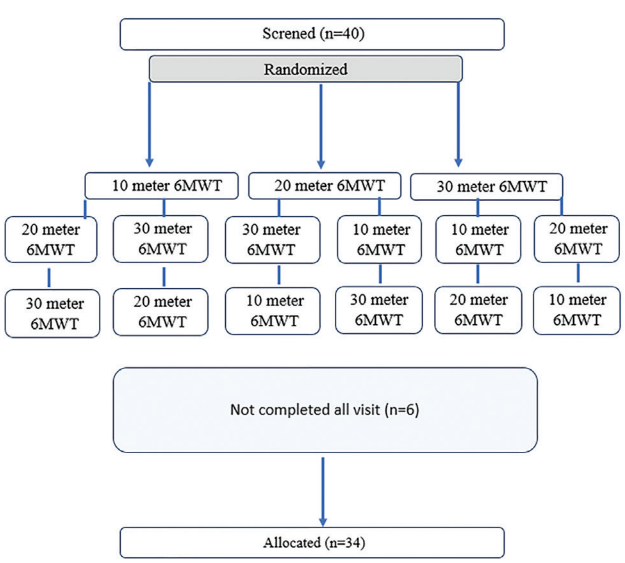

Figure 1. Flowchart and test procedures of the research

6MWT: 6-minute walk test

Table 1. Descriptive variables of participants

Variables	**Statistics (n = 34)**
Age, (year)	
x̄ ± SD	21.2±1.5
M (min-max)	21 (18-25)
Gender, n (%)	
Female	25 (73.5)
Male	9 (26.5)
Height, cm	
x̄ ± SD	168.0±8.5
M (min-max)	165.0 (161.8-172.3)
Weight, kg	
x̄ ± SD	62.3±12.7
M (min-max)	60.0 (51.5-67.6)
Body mass index, kg/m^2	
x̄ ± SD	22.0±2.7
M (min-max)	22.2 (18.6-24.1)
Cigarette consumption, n (%)	
Active smoker	5 (14.7)
Ex-smoker	2 (5.9)
Never smoked	27 (79.4)
Cigarette consumption amount, pack-year	
x̄ ± SD	4.0±1.2
M (min-max)	4 (3-5)

x̄: mean, SD: standard deviation, M: median, min: minimum, max: maximum

DISCUSSION

This study investigated whether corridor length influences performance and hemodynamic responses during the 6MWT in healthy young adults. The main findings were: (1) walking distance and walking speed were significantly lower in the 10-meter corridor compared with the 20- and 30-meter corridors; (2) step counts remained similar across all conditions; and (3) hemodynamic responses were largely comparable, except for higher post-test fatigue and greater dyspnea during recovery in the 10-meter corridor. This study aimed to investigate the impact of corridor length on various performance metrics (distance, step count, walking speed, and percentage of predicted values) and on detailed hemodynamic responses measured before, after, and during recovery, in contrast to earlier research that primarily focused on walking distance. In this respect, it differs from previous studies and offers a particular perspective.

The ATS and ERS recommended a 30-meter corridor for 6MWT.[2,13] However, it may not always be possible in a clinical setting due to the clinic's physical space and environmental factors. The circumstances prompted researchers to investigate whether different corridor lengths affected the 6MWT distance

Table 2. Comparison of the variables in pre-test, post-test, recovery 3rd min, and recovery 5th min

	10 m-6MWT	20 m-6MWT	30 m-6MWT	ICC (95%)	*P* values
Pre-test variables					
Heart rate, bpm	88.78±12.71	86.41±13.41	87.06±13.71	0.66 (0.50/0.80)	0.780
SBP, mmHg	113.74±13.69	116.79±14.78	114.32±17.19	0.27 (0.12/0.43)	0.639
DBP, mmHg	72.94±11.31	74.71±9.86	73.09±9.60	0.41 (0.23/0.54)	0.579
Respiratory rate, breaths per minute	25±3	25±3	25±3	0.36 (0.12/0.39)	0.631
Oxygen saturation, %	98.29±1.09	98.09±1.20	98.18±1.32	0.37 (0.24/0.51)	0.826
Dyspnea, 0-100	0.15±0.56	0.12±0.40	0.12±0.41	0.41 (0.29/0.68)	0.969
Fatigue, 0-100	0.41±0.16	0.50±0.17	0.50±0.05	0.71 (0.56/0.83)	0.947
Post-test (recovery 1st minute) variables					
Heart rate, bpm	98.21±18.02	96.74±19.76	98.47±22.18	0.58 (0.39/0.74)	0.269
SBP, mmHg	121.47±13.31	124.94±23.84	126.41±20.86	0.36 (0.19/0.53)	0.321
DBP, mmHg	73.65±13.83	75.55±8.22	77.29±15.03	0.29 (0.21/0.42)	0.234
Respiratory rate, breaths per minute	29±4	30±4	29±5	0.37 (0.30/0.53)	0.640
Oxygen saturation, %	97.80±1.03	97.09±3.81	97.88±1.87	0.51 (0.26/0.61)	0.580
Dyspnea, 0-100	2.85±0.83	2.76±0.52	2.88±0.53	0.70 (0.53/0.82)	0.827
Fatigue, 0-100	3.61±0.81[a]	3.15±0.33[b]	3.27±0.54[b]	0.53 (0.33/0.70)	0.048*
Recovery 3rd minute variables					
Heart rate, bpm	92.88±14.64	92.21±16.95	92.06±15.23	0.77 (0.63/0.87)	0.895
SBP, mmHg	117.50±13.17	113.91±24.67	118.53±17.48	0.30 (0.18/0.52)	0.620
DBP, mmHg	73.41±10.51	76.56±13.60	74.97±12.90	0.35 (0.28/0.48)	0.352
Respiratory rate, breaths per minute	25±4	25±3	24±4	0.57 (0.49/0.68)	0.154
Oxygen saturation, %	97.71±1.85	97.82±2.37	98.09±1.66	0.39 (0.24/0.51)	0.697
Dyspnea, 0-100	2.00±0.23	1.74±0.13	1.71±0.30	0.62 (0.44/0.77)	0.241
Fatigue, 0-100	2.35±0.39	2.29±0.22	2.35±0.50	0.52 (0.32/0.70)	0.697
Recovery 5th minute variables					
Heart rate, bpm	89.47±15.18	89.88±13.63	91.02±14.29	0.76 (0.62/0.86)	0.673
SBP, mmHg	114.97±20.35	112.64±10.88	113.52±12.86	0.42 (0.21/0.63)	0.647
DBP, mmHg	73.53±11.30	72.97±8.87	72.82±9.96	0.46 (0.25/0.66)	0.421
Respiratory rate, breaths per minute	24±4	24±4	24±3	0.40 (0.32/0.59)	0.941
Oxygen saturation, %	97.68±1.85	98.18±1.31	97.82±2.78	0.29 (0.17/0.51)	0.252
Dyspnea, 0-100	0.50±0.82[c]	0.29±0.58[d]	0.24±0.70[d]	0.58 (0.39/0.74)	0.029*
Fatigue, 0-100	1.25±0.76	1.02±0.74	1.46±0.91	0.51 (0.31/0.70)	0.708

All three groups were compared with the Friedman test. For pairwise comparison, the Wilcoxon signed-rank test with Bonferroni correction was applied. *$P < 0.05$ indicates a significant difference. The letters a, b, c, and d are used to indicate statistical differences. Test values with different letters indicate a statistically significant difference

6MWT: 6-minute walk test, ICC: intraclass correlation coefficient, SBP: systolic blood pressure, DBP: diastolic blood pressure, min: minute

Table 3. Comparison of test results

	10 m-6MWT	20 m-6MWT	30 m-6MWT	ICC (95%)	*P* values	Kendall's W
Walking distance, meter	684.19±55.48[a]	739.24±59.08[b]	742.73±61.84[b]	0.82 (0.71/0.90)	**<0.001***	0.72
Percentage of predicted walking distance, %	89.95±7.73	93.67±8.05	94.03±7.93	0.67 (0.59/0.81)	**<0.001***	0.66
Percentage of predicted maximum heart rate, %	64.82±9.24	58.51±10.17	59.96±10.49	0.57 (0.51/0.63)	**<0.001***	0.69
Step counts, step	757±52	750±56	745±55	0.87 (0.78/0.93)	0.065	0.16
Walking speed, meter/sec	1.34±0.15[c]	1.50±0.16[d]	1.48±0.17[d]	0.57 (0.49/0.71)	**0.30***	0.21

All three groups were compared with the Friedman test. For pairwise comparison, the Wilcoxon signed-rank test with Bonferroni correction was applied. *$P < 0.05$ indicates a significant difference. The letters a, b, c, and d are used to indicate statistical differences. Test values with different letters indicate a statistically significant difference

6MWT: 6-minute walk test, ICC: intraclass correlation coefficient, sec: second

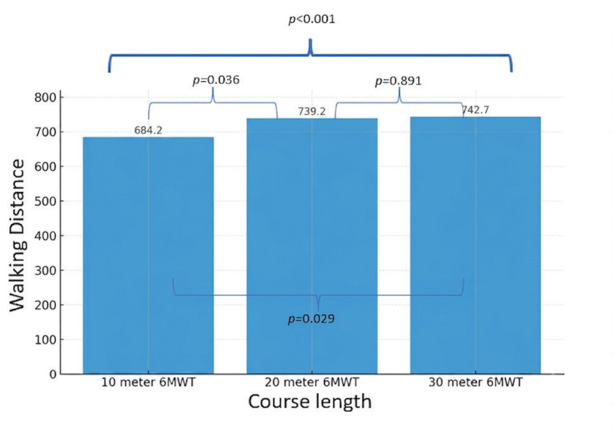

Figure 2. Comparing to walking distance in 10-, 20-, and 30-meter 6MWTs

6MWT: 6-minute walk test

and hemodynamic response to the test. Most of the research conducted on chronic obstructive pulmonary disease[7,9,10] examined individuals using one corridor length; however, studies of individuals with different chronic diseases and healthy individuals used different corridor lengths.[6,8,18,19] According to the findings of the systematic review by Ngueleu et al.[20], there is evidence that the conditions under which the 6MWT is administered have a substantial impact on the score. However, there is a study that suggests this impact was not clinically relevant.[21] Studies used corridors of 10, 15, 20, and 30 meters showed that shorter corridor lengths negatively affected walking distance, with the longest distances being achieved in corridors of 30 meters,[6,8,18] and the reference equations created for 30-meter corridors cannot be used for different corridor lengths.[7,9] Only one study by Gochicoa-Rangel et al.[8], which compared the results of the 6MWT performed in a corridor of 15 and 30 meters in patients with chronic respiratory disease, found similar test results. In healthy adults, Chuatrakoon et al.[11] found that <20-meter corridors varied results compared to the standard length. Our study supported previous studies' findings regarding 6MWT results in different corridors. The longest walking distance was recorded in the 30-meter corridor and was statistically similar to that recorded in the 6MWT performed in the 20-meter corridor. The shortest walking distance, the lowest predicted walking distance, and the highest predicted maximum heart rate were recorded in the 10-meter corridor. The shorter 6MWT distance achieved on a 10-meter corridor may be due to the increased number of turns required on such a short corridor.[7,18] More turns require more deceleration. This is supported by the observation that participants had a lower average speed in the 10-meter corridor despite similar step counts in our study. In addition, our participants exhibited higher fatigue values during the 10-meter 6MWT. This may be another reason for the reduced walking distance observed in the 10-meter corridor. Chuatrakoon et al.'s[11] study, conducted on healthy adults, showed similar results, although the average walking performance of the participants was found to be lower than our results. Since that study did not include predicted values, step count, and average speed, as our study did, no conclusions can be drawn. This difference may be attributable to the age range, gender distribution, and height of the included population. In this study, walking performance was interpreted using predictive equations adjusted for age, sex, weight, and height thereby reducing potential bias related to demographic differences. Despite these adjustments, age- and sex-related physiological variability in cardiovascular responses may still influence hemodynamic outcomes. Thus, caution is warranted when extrapolating these findings beyond the studied population.

The 6MWT differed significantly across corridor lengths ($P < 0.001$), with a large effect size Kendals W = 0.72. Although the ICC indicated good agreement between the tests (ICC: 0.82), participants walked a substantially shorter distance in the 10-m corridor than in the 20-m and 30-m corridors. The distances obtained from the 20-m and 30-m corridors were very similar, indicating that the 20-m corridor may provide comparable results to the standard 30-m corridor. Despite relatively high ICC values, the systematic reduction in walking distance observed in the 10-m corridor indicates that this configuration should not be considered a comparable alternative to longer corridors.

Responses to the 6MWT, including walking distance, are also important. For this reason, post-test heart rate, SpO_2, dyspnea, and fatigue were frequently examined in studies.[7,8,10,18] According to the study results, at the end of the test there was a minimal increase in heart rate, dyspnea, and fatigue, and a minimal decrease in SpO_2, particularly among patient groups. Additionally, different corridor lengths in 6MWTs did not affect test responses. However, recovery responses were not examined in these studies. In our study, we measured heart rate, SpO_2, blood pressure, respiratory rate, dyspnea, and fatigue at pre-test, post-test, R3, and R5. Responses were similar across all time periods. However, post-test fatigue and R5 dyspnea were higher when the 6MWT was performed in the 10-meter corridor. This difference may be due to a greater number of turns in the shorter corridor. The deceleration-acceleration cycle during turns may have contributed to increased fatigue and dyspnea.

Strengths of this study include the randomized crossover design, standardized testing procedures, and inclusion of recovery measurements, which have been underreported in prior research. However, several limitations should be acknowledged. Because only healthy young adults aged 18–25 years were included, the findings may not be generalizable to older adults or individuals with comorbidities. Age-related physiological and clinical changes could alter the observed relationships. Further research involving a wider age spectrum is warranted. Second, the sample was predominantly female, which may have influenced outcomes. Third, physical activity levels were not assessed, which could have affected walking performance. Another limitation of this study is that period, sequence, and potential carryover effects inherent to the crossover design were not formally evaluated. Although the order of the corridor conditions was randomized and rest periods were provided between tests to minimize these effects, their potential influence cannot be completely ruled out. Finally, although a smartwatch was used to objectively measure walking speed and step counts, validation of this device for use in the 6MWT is warranted.

CONCLUSION

This study demonstrated that corridor length significantly affects 6MWT outcomes in healthy young adults. While hemodynamic responses were largely comparable across 10-, 20-, and 30-meter corridors, the 10-meter corridor consistently produced shorter walking distances—approximately 60 meters shorter—and higher subjective fatigue and dyspnea than in the longer corridors. These findings suggest that using a 10-meter corridor may compromise the validity of the 6MWT. In contrast, a 20-meter corridor produced results comparable to those obtained under the standard 30-meter condition, suggesting that it may be a feasible alternative for clinical settings with limited space.

Ethics

Ethics Committee Approval: The entire study process was conducted in accordance with the principles of the Declaration of Helsinki. Ethical approval was obtained from the İzmir Katip Çelebi University Non-Interventional Research Ethics Committee (approval no: 382, date: 22.09.2022, 2024/08/05).

Informed Consent: All study details were explained to all participants, and written informed consent was obtained.

Footnotes

Authorship Contributions

Surgical and Medical Practices: M.K., Concept: M.K., B.T., Design: M.K., E.F., İ.N., Data Collection or Processing: M.K., B.T., Analysis or Interpretation: M.K., E.F., İ.N., Literature Search: M.K., B.T., E.F., İ.N., Writing: M.K.

Conflict of Interest: No conflict of interest was declared by the authors.

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