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INVESTIGATION OF FUNCTIONAL STATUS, BALANCE AND KINESIOPHOBIA IN WOMEN WITH HALLUX VALGUS UNDERWENT CHEVRON OSTEOTOMY, A PILOT STUDY

ORIGINAL ARTICLE

ABSTRACT

Purpose: The aim of this study, was to investigate functional status, balance and kinesiophobia after Chevron osteotomy in women with Hallux Valgus (HV) in comparison to non-surgical women with HV. Another aim was to compare the pre- and post-surgical radiographic values of women with HV who underwent surgery.

Methods: A total of 38 individuals were included in the study, including aged 20-70 years 19 women with an average of 28 months after surgery and 19 HV women diagnosed with non-surgical. Individuals' pain intensity (Visual Analogue Scale), thumb joint range of motion (ROM) (universal goniometer), static balance (Single-Leg-Stance Test), dynamic balance (Timed Up and Go Test), functional status and cosmetic concern (Multidimensional Nil Hallux Valgus Scale), kinesiophobia (Tampa Kinesiophobia Scale) was evaluated.

Results: Pain severity, cosmetic concern, ROM of the thumb and HV angle (HVA) were lower in women with HV following surgery than non-surgical HV women ($p<0.001$); functional scores were better than women with non-surgical HV ($p<0.05$). Balance and kinesiophobia scores were similar in both groups ($p>0.05$). However, the average kinesiophobia scores in both groups (surgical: 36.20 ± 5.35; non-surgical: 36.44 ± 5.40) were above the mean score of the scale. HVA and 1-2 intermetatarsal angle of the surgical group showed significant improvement compared to the values before surgery ($p <0.001$).

Conclusion: The results of this study showed that the total ROM of thumb is limited and long-term post-surgical kinesiophobia in women with HV. For a comprehensive evaluation of these individuals, it should be taken into consideration that joint movements and kinesiophobia evaluations should be added to physiotherapy and rehabilitation programs before and after surgery.

Key Words: Function, Hallux Valgus, Kinesiophobia, Range of Motion, Postural Balance

CHEVRON OSTEOTOMİSİ GEÇİREN HALLUKS VALGUSLU KADINLARDA FONKSİYONEL DURUM, DENGE VE KİNEZYOFOBİNİN İNCELENMESİ: PILOT ÇALIŞMA

ARAŞTIRMA MAKALESİ

ÖZ

Amaç: Bu çalışmanın amacı, Halluks Valgus'lu (HV) kadınların Chevron osteotomisi sonrası fonksiyonel durumunu, dengesini ve kinezyofobisini HV tanılı cerrahi geçirmemiş kadınlarla karşılaştırmalı olarak incelemekti. Bir diğer amacımız ise cerrahi geçiren HV'li kadınların cerrahi öncesi ve sonrası radyografik değerlerini karşılaştırmaktı.

Yöntem: Çalışmaya 20-70 yaşları arasında, cerrahi sonrası ortalama 28 ay süre geçmiş 19 HV'li kadın ve cerrahi geçirmemiş HV tanılı 19 kadın olmak üzere toplam 38 birey dahil edildi. Bireylerin ağrı şiddeti (Vizüel Analog Skalası), başparmak eklem hareket açıklığı (universal gonyometre), statik dengesi (Tek Bacak Üzerinde Durma Testi), dinamik dengesi (Zamanlı Kalk Yürü Testi), fonksiyonel durumu ve kozmetik kaygısı (Çok Boyutlu Nil Halluks Valgus Ölçeği), kinezyofobisi (Tampa Kinezyofobi Ölçeği) değerlendirildi.

Sonuçlar: Cerrahi geçiren HV'li kadınların ağrı şiddeti, kozmetik kaygısı, başparmak toplam eklem hareket açıklığı ve HV açısı cerrahi geçirmeyen HV'li kadınlara oranla daha düşüktü ($p<0,001$); fonksiyonel skorları ise cerrahi geçirmeyen HV'li kadınlara göre daha iyi durumdaydı ($p<0,05$). Denge ve kinezyofobi skorları her iki grupta benzerdi ($p>0,05$). Ancak her iki grubun da ortalama kinezyofobi puanları (cerrahi olan: 36,20 ± 5,35; cerrahi olmayan: 36,44 ± 5,40), ölçeğin ortalama puanının üstündeydi. Cerrahi grubunun HV ve 1-2 intermetatarsal açısı, cerrahi öncesindeki değerlere göre anlamlı iyileşme gösterdi ($p<0,001$).

Tartışma: Bu çalışmanın sonuçları, HV'li kadınlarda cerrahi sonrası uzun dönemde başparmak toplam eklem hareket açıklığının kısıtlandığını ve kinezyofobinin varlığını göstermektedir. Bu bireylerde kapsamlı bir değerlendirme için, cerrahi öncesinde ve sonrasında eklem hareketlerinin ve kinezyofobi değerlendirmelerinin de fizyoterapi ve rehabilitasyon programlarına eklenmesinin gerektiği göz önünde bulundurulmalıdır.

Anahtar Kelimeler: Fonksiyon, Halluks Valgus, Kinezyofobi, Eklem Hareket Açıklığı, Postural Denge

INTRODUCTION

Hallux valgus (HV) is one of the most common and disabling deformities of the foot (1). It affects 12-56% of the population over the age of 65, its prevalence increases with age and is more common in women (2). HV is the medial orientation of the 1st metatarsal (MT) with lateral deviation and internal rotation of the thumb. These changes in foot posture cause disorders in the functioning of intrinsic muscles. This situation exacerbates the deformity (3). Increasing the severity of the deformity causes an increase in pain intensity and cosmetic anxiety, and a decrease in quality of life (4).

With HV deformity, the extension range of motion (ROM) of the thumb decreases and the plantar load distribution shifts laterally. Thus, normal gait biomechanics are impaired. This situation leads to hypermobility of the forefoot, leading to a decrease in functional performance such as difficulty in walking, decrease in walking distance, pain while walking (5). In addition, the thumb plantar flexors have been shown to contribute significantly to postural control and are particularly important in controlling the mediolateral sway in intrinsic muscles such as the abductor hallucis (6). It has also been shown that changes in the traction angle of these muscles with HV deformity and secondary problems occurring in the joints cause an increase in mediolateral sway in individuals with HV and negatively affect the balance (7). In addition, it has been reported that the risk of falling increases with age in these individuals (8). It has been stated that all these factors such as increased pain intensity, limitations in joint movement, body mass index, age, and avoidance of re-injury after surgery cause fear of movement (9). There are studies related to orthopedic injury or post-surgery kinesophobia, (10, 11) but there is no study investigating kinesiophobia in individuals with HV or in the process after HV surgery.

Chevron osteotomy is widely accepted and applied distal metatarsal osteotomy for the correction of mild to moderate HV deformity. It is the surgical technique chosen in cases where the hallux valgus angle (HVA) is less than 30° and 1-2 intermetatarsal angle (IMA) are normal. The advantages of this surgical procedure are stable osteotomy geometry, rapid recovery and minimal shortening of the 1st MT (12). It has been shown that this osteotomy provides excellent results in terms of improvement in functional scores and patient satisfaction rates as well as radiographic improvement of HV deformity (13). In addition, improvements in static balance were observed in the early period after HV surgery (14). However, due to the multifactorial reason, it has been shown that there is a limitation in the ROM of the thumb joint after HV surgeries. Therefore, it has been emphasized that individuals with HV have difficulty walking after surgery and this affects their surgical satisfaction (15).

There are no studies in the current literature examining long-term balance and kinesiophobia after HV surgery. Therefore, this situation does not allow us to understand the long-term effect of HV surgery on balance and fear of movement. The aim of this study was to examine the functional status, balance, and kinesiophobia of women with HV who underwent Chevron osteotomy, compared to women with HV who had not undergone surgery.

METHODS

Study participants

Nineteen women who were diagnosed with HV, who underwent Chevron osteotomy by the same surgeon and 19 volunteers who were admitted to the outpatient clinic, diagnosed with HV, did not undergo surgery, were included in the study. In order to carry out the study, approval was obtained from the Non-Interventional Clinical Research Ethics Committee of Hacettepe University on June 12, 2018 with the decision number GO 18/464-20. The study was conducted in Hacettepe University, Faculty of Physical Therapy and Rehabilitation, Department of Physiotherapy and Rehabilitation, Early Orthopedic Rehabilitation Unit between July 2018 and December 2019.

Inclusion criteria for the study were, for the control group, were diagnosed with HV by a specialist in the field based on radiographic measurement and had an HVA of more than 15 degrees; For the surgical group, they had had HV surgery with Chevron osteotomy and had at least 6 months and a maximum of 5 years after surgery. The common inclusion criteria for the groups were being between the

ages of 20-70 and being a female patient, being conscious and communicable, and volunteering. Common exclusion criteria for groups; extremity inequality, having received physiotherapy and rehabilitation treatment in the last 1 year, having a neurological disorder that may affect balance, having a diagnosis of hip and / or knee osteoarthritis and rheumatoid arthritis, and having another previous hip, knee and foot-ankle surgery.

Individuals included in the study were asked to sign the written informed consent form that declared that they were volunteers.

Outcome measurements

First of all, demographic information such as age, gender, height, body weight, occupation of the individuals and clinical information such as the date of surgery and the affected extremity were recorded.

Multidimensional Nile Hallux Valgus Scale

It is a holistic evaluation scale specific to HV developed by Bek et al. It consists of a total of 14 questions divided into 5 sections. In the first part, the pain intensity is evaluated with the Visual Analogue Scale (VAS), where a place on a 10 cm straight line drawn between no pain (0) and unbearable pain (10) points is marked by the patient. In the second part, 4-point Likert scale (Never = 0, Sometimes = 1, Mostly = 2, Always = 3) is used to evaluate daily life activities and cosmetic anxiety. In the third part, the ROM of the thumb is evaluated with a universal goniometer. The last two sections are the section in which accompanying pathologies such as pes planus are evaluated. The total score is between 0-60, the higher the score; indicates increased symptoms, complications and functional problems (16). The questions in the scale were for the surgical group, the operated foot; for the control group, the answer was given by considering the foot with HV diagnosis. Permission was obtained from the author to use the Nil HV Scale in our study.

Assesment of ROM

Dorsiflexion, abduction and adduction angles of the thumb were evaluated with a universal goniometer. While the passive dorsiflexion range of the big toe was evaluated, the metatarsophalangeal (MTF) joint was the pivot point and the goniometer was placed medial to the foot. The fixed arm of the goniometer was held parallel to the 1st MT bone, and the movable arm followed the thumb. The HV deformities of the patients were passively corrected, and the thumb was passively dorsiflexed from the MTF joint, and the angle was recorded. While evaluating the passive abduction angle of the big toe, the MTF joint was the pivot point, and the goniometer was placed on the dorsal aspect of the foot. The fixed arm of the goniometer was held parallel to the 1st MT bone, and the movable arm followed the thumb. The HV deformities of the patients were corrected passively, the thumb was passively abducted, and the angle was recorded. In the evaluation of the adduction angle of the thumb in the static position, the MTF joint of the thumb was the pivot point and the goniometer was placed on the dorsal aspect of the foot. The fixed arm of the goniometer was held parallel to the 1st MT bone and the movable arm was placed parallel to the thumb, and the angle in the static position was recorded.

Assesment of static balance

In our study, we used the Single-Leg-Stance Test (SLST) to evaluate static balance. We chose this test because of its clinical applicability and easy understanding by the patient. Patients were asked to lift one foot without touching the supporting leg and to maintain balance for 30 seconds (sec). The test was done separately, with eyes open and closed. Three measurements were made with a stopwatch and the average time was recorded. The test was applied to both legs. The test was terminated when the lifted leg touched the other leg or the foot touched the ground, when the standing on the ground jumped, or when supported by anything in the environment. It has been stated that if the terminated value is below 10 seconds, there is an imbalance, and if it is below 5 seconds, there is a risk of falling (17). Statistical analysis of the test, for the surgical group, the operated foot; for the control group, the static balance times on the diagnosed foot were taken into account.

Assesment of dynamic balance

Dynamic balance was evaluated with the Timed Up and Go (TUG). The reason we used this test in our study was that it was known that this test was related to the pain of the big toe (18). A standard size chair with back support was used in the test. First,

the patient was asked to sit on a chair. Then the chair was asked to stand up from the seat without support from the arm cuffs, to walk at a normal pace, not fast at a distance of 3 meters (m) measured before, and to turn back and sit on the chair at the end of 3 meters. The time was recorded in sec with the stopwatch.

Assesment of kinesiophobia

Kinesiophobia was assessed using the Tampa Kinesiophobia Scale (TKS). This scale consists of 17 questions in total and the Likert scale used when evaluating the questions is (1 = strongly disagree, 2 = disagree, 3 = agree, 4 = strongly agree). The lowest possible score is 17 and the highest score is 68. Turkish validity and reliability of TKS has been made, and Turkish validation was used in our study (19). In addition, necessary permission was obtained from the author to use TKS in our study.

Radiographic evaluation

HVA on the weight bearing anteroposterior radiographs recorded in the patients' files were evaluated. HVA and 1-2 IMA of the group undergoing surgery were also evaluated before and after surgery. The HVA is the angle between the long axis of the proximal phalanx of the thumb and the long axis of the 1st MT. Lateral deviation up to 15° is considered normal. The 1-2 IMA is the angle between the 1st and 2nd MT long axis and is considered normal up to 9° (20).

Statistical analysis

The conformity of the variables to normal distribution was examined by visual (histogram and probability graphics) and analytical methods (Kolmogorov-Smirnov / Shapiro-Wilk tests). Descriptive statistics were given as mean and standard deviation for numerical variables with normal distribution, median, minimum and maximum values and interquartile range (IQR) for variables not showing normal distribution. Independent Samples t-test was used when comparing data in independent groups showing normal distribution, and Mann-Whitney U test was used when comparing data in independent groups that did not show normal distribution. The Wilcoxon Signed Rank Test was used when comparing the data in dependent groups that did not show normal distribution.

Statistical significance was set at a P-value of <0.05, and analyzes were performed using the Statistical Package for the Social Sciences Version 25.0 software (IBM SPSS Statistics 25.0, IBM Corp. Armonk, NY, USA).

RESULTS

There was no significant difference between the physical characteristics of the individuals participating in the study (Table 1). In the surgery group, the mean duration after surgery was 33.4 (±18.3; range 12-60) months. The distribution of the operated extremities in the surgery group was 36.8% (n = 7) in the right and 63.2% (n = 12) in the left; In the control group, the distribution of the diagnosed extremities was 40.5% (n = 8) right and 59.5% (n= 11) left (Figure 1).

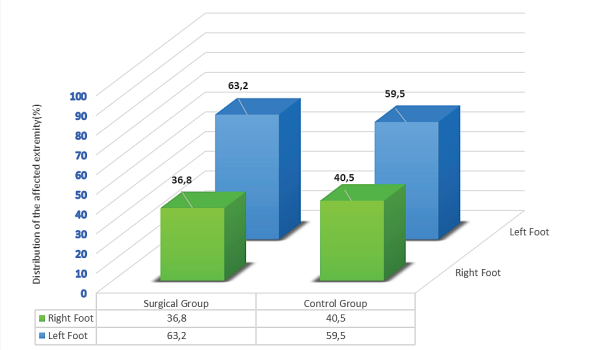

Figure 1. Distribution Graph of Affected Extremes According to Clinical Groups

Table 1. Comparison of Physical Characteristics of Individuals

Physical Characteristics (n=19)	Surgery Group X±SS	Control Group X±SS	P-value
Age (years)	50.83 ± 12.61	45.12 ± 12.10	0.163
Body weight (kg)	68.34 ± 13.00	63.45 ± 8.32	0.174
Height (cm)	160.41 ± 4.25	161.00 ± 6.50	0.613
Body mass ındex (kg/m²)	26.55 ± 4.94	24.56 ± 3.44	0.149

Independent samples t- test, X ± SD: Mean ± standard deviation, n: Number of individuals.

Table 2. Comparison of Pre- and Postoperative Radiographic Values of Surgery Group

Radiographic Angles (n: 19)	Preoperative X±SS	Postoperative X±SS	P-value
HVA (°)	38.66 ± 5.42	16.32 ± 4.43	0.000**
1-2 IMA (°)	16.22 ± 1.56	7.12 ± 1.44	0.000**

Wilcoxon Signed Rank Test, HVA: Hallux valgus angle, IMA: Intermetarsal angle, X ± SD: Mean ± standard deviation, °: Degrees, n: Number of feet surgically, **: P <0.001

In the surgery group, postoperative HVA and 1-2 IMA values were significantly better than before surgery (p <0.001) (Table 2).

There was a significant difference in favor of the surgical group in terms of pain intensity and cosmetic anxiety assessed in the Multidimensional Nile Hallux Valgus Scale (p <0,001). However, the medial longitudinal arch (MLA) height, another parameter evaluated within this scale, were similar in the two groups (p = 0.204). The total score obtained from the Nil Hallux Valgus Scale was better in the surgical group (p = 0.026). The result was in favor of the control group in terms of total ROM of the thumb (p <0.001). The durations of SLST with both eyes open and eyes closed were similar in the two groups (p = 0.839; p = 0.412, respectively). There was no statistically significant difference between the TUG durations of the groups (p = 0.179). TKS scores were very similar in the two groups (p = 0.907). In the comparison of HVA values between the groups, a significant result was found in favor of the surgery group (p <0.001). The comparison of the results of both groups is shown in Table 3.

DISCUSSIONS

The results of this study, in which we examined the functional status, balance and kinesiophobia of women with HV after Chevron osteotomy in comparison with women diagnosed with HV and who have not undergone surgery; the surgical group had low pain intensity, less cosmetic anxiety, inadequate total thumb ROM, low HVA, Nil HV Scale, which evaluates functional status showed that the total score was better. However, MLA height, balance, and kinesiophobia results were similar in both groups

The presence of pain symptom in HV is one of the most important reasons for preferring surgery and

Table 3. Comparison of Results of Surgical and Non-Surgical Groups

		Surgical Group Median (IQR) (n_1= 19)	**Control Group Median (IQR) (n_2= 19)**	**P-value**
Pain Severity (0-10 cm)		1.00 (0.00/ 3.50)	4.00 (2.60/ 6.00)	0.000**
Cosmetic Concern (0-3 point)		0.00 (0.00/ 1.00)	3.00 (3.00/ 3.00)	0.000**
MLA Height		1.00 (0.60/ 1.10)	1.00 (0.90/ 1.20)	0.204
Static Balance (sec)	Eyes Open	22.80 (11.33/ 30.00)	25.66 (11.00/ 30.00)	0.839
	Eyes Close	5.10 (3.22/ 7.00)	4.00 (2.66/ 12.00)	0.412
		X±SS (n_1= 19)	**X±SS (n_2= 19)**	**P-value**
Total Thumb ROM (°)		59.50±12.45	81.95±10.72	0.000**
Dynamic Balance (sec)		7.90 ± 1.10	7.55 ± 1.00	0.179
TKS (17-68 point)		36.20 ± 5.35	36.44 ± 5.40	0.907
Nile Hallukx Valgus Scale Total Point (0-60 point)		15.66 ± 8.72	19.51 ± 6.60	0.026*
HVA (°)		16.32 ± 4.43	24.33 ± 4.65	0.000**

MLA: Medial longitudinal arch, ROM: Range of motion, TKS: Tampa kinesophobia scale, HVA: Hallux valgus angle, IQR: Interquartile range, X ± SS: Mean ± standard deviation, °: Degrees, sec: Seconds, n_1: Surgical number of feet, n_2: Number of feet diagnosed, *:P <0.05, ** P <0.001.

one of the most important long-term indicators of the success of the surgery (21). In studies involving individuals with HV who have undergone surgery, it has been shown that VAS scores, which were 6 points before surgery, decreased to 1 point in the postoperative period (22,23). The average VAS score of the surgical group in our study was 1 (range 0-3) points, consistent with the literature, and the pain intensity was lower than the control group.

Another factor that ranks second in the reasons for surgery for individuals with HV and affects patient satisfaction the most in surgical results is the problems associated with cosmetic anxiety (24). The lack of a special scale that evaluates cosmetic anxiety after HV surgery or the patient's satisfaction with the appearance of her foot has been mentioned (24). Nil HV Scale, with its multidimensional structure, is the only scale developed that evaluates this cosmetic anxiety in patients. In a study that followed a 40 HV individual who had undergone chevron osteotomy for an average of 43 months, while only one of the patients stated dissatisfaction with the appearance of their feet, 97.50% satisfaction was reported after surgery (25). In another study, individuals with 110 HV who were followed for an average of 39 months were divided into two groups as those who had proximal and distal surgery, and stated that 95% of patients who had proximal surgery and 96% in the distal group were patient satisfaction (26). The cosmetic concerns of the individuals who participated in our study and had surgery were similar to the satisfaction percentages of previous studies. However, while these studies present a comparison of the results before and after HV surgery; In our study, we compared the cosmetic anxiety values of patients with HV who did not undergo surgery and those who had surgery, and we found that patients who underwent surgery had lower cosmetic concerns.

In HV surgery, improvements in balance control can be achieved by several mechanisms. First of all, the correction of the position of the thumb can allow for a better input of proprioception, as well as a better 1st MTF ROM. Another mechanism is that a better tactile sensation on the plantar surface of the foot after surgery can provide more accurate proprioceptive feedback. Finally, as a result of biomechanical smoothness, improvement in postural stability can be seen with reduction in pain intensity (14). However, there are almost no studies examining balance after HV surgery. Only one study examined early results of the effect of HV surgery on balance. In this study, it was reported that there was less oscillation in the center of mass than in the preoperative group in static balance results at 4-12 weeks after HV surgery. In the same study, no difference was found between the groups for dynamic balance and it was stated that there may be improvements in walking outcomes after long-term surgery (14). There are studies that include long-term results after correction of HV deformity in different age groups with different surgical approaches (13, 27). These studies focus more on function and radiographic results; however, there is no study examining the effect of surgery on balance in the long term. In our study, in which we included female HV patients who had an average of 33.4 months after surgery, the balance values of the cases were found to be similar to the values of female patients who did not undergo surgery. Although there was no statistical difference between the balance results in our study, we observed that the group that did not undergo surgery had better static and dynamic balances. The insufficient sensitivity of the tests we use to evaluate balance may have caused these results. Although our groups were homogeneous in terms of age, the average age of non-surgical HV individuals (45.1 years) was lower than those in the surgical group (50.8 years). Accordingly, factors affecting balance such as visual, vestibular, proprioception, strength and reaction time, which decrease with age, may have affected our results.

There was no study investigating kinesiophobia in individuals with HV or in the process after HV surgery. In our study, kinesiophobia was examined comparatively in individuals with HV who had surgery and who did not undergo surgery, but who were diagnosed with HV. In our results, it was found that the kinesiophobia scores of the two groups were very similar. In addition, the mean scores of both groups (surgical: 36.2 ± 5.3; non-surgical: 36.4 ± 5.4) were above the mean score of the scale. Lentz et al. investigated how pain-related fear of movement alone is effective in foot-ankle insufficiency in their study, in which they included 85 patients

with complaints of foot-ankle or who received various diagnoses but did not undergo surgery (9). As a result of the study, it has been proven that pain-related fear of movement is significantly associated with foot-ankle insufficiency. In the light of this study, we can predict that the presence of kinesiophobia in individuals with HV who have undergone surgery or who have not, will affect their foot-related functions and this situation may negatively affect their independence and participation in their daily lives.

It has been proven in many studies that there is a decrease in the ROM of the thumb joint after HV surgeries (15, 25). The results of our study were consistent with previous studies, and a significant difference was found between the thumb total ROM values of individuals with HV (59.5°) who underwent surgery and individuals with HV (81.9°) who had not undergone surgery. Thumb joint movement should be within normal limits in daily life activities and during walking, especially finger lifting. In order for a normal push-off phase to occur in walking, the 1st MTF joint should allow dorsal flexion of at least 30-40° (5). After HV surgery, reduced ROM of the thumb and impaired plantar load distribution may affect the normal gait pattern and cause extra energy consumption. This may also affect the functional results of the surgery (15).

The decrease in the total score obtained from the Nile HV Scale is an indicator that the symptoms, functional status and other accompanying pathologies (such as MLA height, callus) are good in individuals with HV. However, unfortunately, there is no study in which this scale was used in individuals with HV in the postoperative period. One of our aims to prefer this scale in our study was to eliminate this important deficiency in the literature. In our study, the lower total scores of the Nil HV Scale in our patients who underwent surgery showed us that the symptoms were less and functional competence was better. Together with the positive contribution of the post-surgical physiotherapy process to functional recovery, this result can better meet the expectations of the patients (28).

In the literature, the most frequently compared values are HVA and 1-2 IMA in order to evaluate the success of the surgery and to determine which surgical technique is more successful. The HVA and 1-2 IMA values of the surgical group in our study were lower than before surgery. In addition, postoperative HVA values of individuals who underwent surgery were lower than those who did not have surgery. One of the primary goals of surgery is the correction of angular deformity. Studies have shown similarity with our results, showing significant decreases in radiographic measurements after HV surgery (29).

Our study has some limitations. The findings of this study are limited by the small sample size. Therefore, we presented our results as a pilot study. In addition, preoperative and early postoperative evaluation results were not available. Performing these pre-surgical evaluations would have contributed to obtaining more accurate information about postoperative functional status and balance. Including the results of healthy individuals in our study could provide us with a better understanding of the effect of HV deformity on functional status, balance and kinesiophobia, and the effectiveness of HV surgery. In our study, there was no individual with a bilateral diagnosis or a history of surgery. Bilateral pathology could lead to different results. In addition, using more reliable methods of balance assessment could increase the reliability of our results.

As a result, a decrease in 1st MTF total ROM and the presence of kinesiophobia were observed in the long term after surgery in individuals with HV. In addition, individuals with HV who underwent surgery had worse balance results; however, it was found to be not statistically significant. These results indicated that joint movements, kinesiophobia and balance should be included in the pre- and postoperative (early and long-term) physiotherapy and rehabilitation evaluations. With such a comprehensive evaluation, the physical needs of individuals with HV after surgery can be determined and contribution can be made to the creation of individual physiotherapy and rehabilitation programs; it can also help surgeons evaluate their surgical success.

In order to better understand the effect of HV surgery on balance and kinesiophobia in future research, they can conduct studies comparing the presence of pre- and postoperative (early and long-term) kinesiophobia in individuals with HV and the balance results evaluated with more objective

methods with those of healthy individuals or individuals with bilateral diagnosis.

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Conflict of Interest: None to be declared by any of the authors.

Ethical Approval: Ethical approval was obtained from the Non-Invasive Clinical Research Ethics Committee of Hacettepe University on June 12, 2018 with the decision of GO 18 / 464-20.

Informed Consent: Prior to the study, individuals were informed about the purpose of the study, the duration of the study, the content of the evaluations and questionnaires, and signed an informed consent form that they voluntarily participated in the study.

Peer-Review: Externally peer-reviewed

Author Contributions: Concept- MMC, GİK; Design- MMC, GİK, OC; Supervision/Consultancy - GİK, OC; Resources - GİK; Materials - MMC, OC; Data Collection and /or Processing - MMC, GİK; Analysis and/ or Interpretation - GİK; Literature Review - MMC, GİK, OC; Manuscript Writing - MMC, GİK; Critical Review - GİK, OC.

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REFERENCES

1. Kuhn J, Alvi F. Hallux valgus. StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing, 2020 Jan.
2. Nguyen US, Hillstrom HJ, Li W, Dufour AB, Kiel DP, Procter-Gray E, et al. Factors associated with hallux valgus in a population-based study of older women and men: the Mobilize Boston Study. Osteoarthritis Cartilage. 2010;18(1):41-6.
3. Nix SE, Vicenzino BT, Collins NJ, Smith MD. Characteristics of foot structure and footwear associated with hallux valgus: a systematic review. Osteoarthritis Cartilage. 2012;20(10):1059-74.
4. Abhishek A, Roddy E, Zhang W, Doherty M. Are hallux valgus and big toe pain associated with impaired quality of life? A cross-sectional study. Osteoarthritis Cartilage. 2010 Jul;18(7):923-6.
5. Kawakami W, Takahashi M, Iwamoto Y, Shinakoda K. Coordination among shank, rearfoot, midfoot and forefoot kinematic movement during gait in individuals with hallux valgus. J Appl Biomech. 2018:1-23.
6. Kelly LA, Kuitunen S, Racinais S, Cresswell AG. Recruitment of the plantar intrinsic foot muscles with increasing postural demand. Clin Biomech (Bristol, Avon). 2012;27(1):46-51.
7. Nishimura A, Ito N, Nakazora S, Kato K, Ogura T, Sudo A. Does hallux valgus impair physical function? BMC Musculoskelet Disord. 2018;19(1):174.
8. Chopra S, Moerenhout K, Crevoisier X. Characterization of gait in female patients with moderate to severe hallux valgus deformity. Clin Biomech (Bristol, Avon). 2015;30(6):629-35.
9. Lentz TA, Sutton Z, Greenberg S, Bishop MD. Pain-related fear contributes to self-reported disability in patients with foot and ankle pathology. Arch Phys Med Rehabil. 2010;91(4):557-61.
10. Kocic M, Stankovic A, Lazovic M, Dimitrijevic L, Stankovic I, Spalevic M, et al. Influence of fear of movement on total knee arthroplasty outcome. Ann Ital Chir. 2015;86(2):148-55.
11. Padovan AM, Kuvacic G, Gulotta F, Sellami M, Bruno C, Isoardi M, et al. A new integrative approach to increase quality of life by reducing pain and fear of movement in patients undergoing total hip arthroplasty: the IARA model. Psychol Health Med. 2018;23(10):1223-30.
12. Dogar F, Ozan F, Gurbuz K, Ekincl Y, Bilal O, Oncel ES, et al. Distal metatarsal osteotomy in hallux valgus surgery: Chevron osteotomy. JCAM. 2015;6:752-5.
13. Van Groningen B, Van der Steen MC, Reijman M, Bos J, Hendriks JG. Outcomes in chevron osteotomy for hallux valgus in a large cohort. Foot (Edinb). 2016 Dec;29:18-24.
14. Sadra S, Fleischer A, Klein E, Grewal GS, Knight J, Weil LS, Sr, et al. Hallux valgus surgery may produce early improvements in balance control: results of a cross-sectional pilot study. J Am Podiatr Med Assoc. 2013;103(6):489-97.
15. Polastri M. Postoperative rehabilitation after hallux valgus surgery: a literature review. Foot Ankle Int. 2011;4(6):13-4.
16. Bek N, Coskun G, Kinikli GI, Karahan S. Development of multidimensional nil hallux valgus scale: a reliability and validity study. Acta Orthop Traumatol Turc. 2016;50(3):269-76.
17. Vellas BJ, Wayne SJ, Romero L, Baumgartner RN, Rubenstein LZ, Garry PJ. One-leg balance is an important predictor of injurious falls in older persons. J Am Geriatr Soc. 1997;45(6):735-8.
18. Yoshimoto Y, Oyama Y, Tanaka M, Sakamoto A. Toe functions have little effect on dynamic balance ability in elderly people. J Phys Ther Sci. 2017;29(1):158-162.
19. Yilmaz ÖT, Yakut Y, Uygur F, ULUĞ N. Turkish version of tampa kinesiophobia scale and test-retest reliability. Physiotherapy Rehabilitation. 2011;22(1):44-9.
20. Srivastava S, Chockalingam N, El Fakhri T. Radiographic measurements of hallux angles: a review of current techniques. Foot. 2010;20(1):27-31
21. MacMahon A, Karbassi J, Burket JC, Elliott AJ, Levine DS, Roberts MM, et al. Return to sports and physical activities after the modified lapidus procedure for hallux valgus in young patients. Foot Ankle Int. 2016;37(4):378-85.
22. Lai SWH, Tang CQY, Graetz AEK, Thevendran G. Preoperative mental health score and postoperative outcome after hallux valgus surgery. Foot Ankle Int. 2018;39(12):1403-9.
23. Choi GW, Kim HJ, Kim TW, Lee JW, Park SB, Kim JK. Sex-related differences in outcomes after hallux valgus surgery. Yonsei Med J. 2015;56(2):466-73.
24. Schrier JC, Palmen LN, Verheyen CC, Jansen J, Koeter S. Patient-reported outcome measures in hallux valgus surgery. A review of literature. Foot Ankle Surg. 2015;21(1):11-5.
25. Ozkurt B, Aktekin CN, Altay M, Belhan O, Tabak Y. Range of motion of the first metatarsophalangeal joint after chevron procedure reinforced by a modified capsuloperiosteal flap. Foot Ankle Int. 2008;29(9):903-9.
26. Park HW, Lee KB, Chung JY, Kim MS. Comparison of outcomes between proximal and distal chevron osteotomy, both with supplementary lateral soft-tissue release, for severe hallux valgus deformity: A prospective randomised controlled trial. Bone Joint J. 2013;95(4):510-6.
27. Jeuken RM, Schotanus MG, Kort NP, Deenik A, Jong B, Hendrickx RP. Long-term follow-up of a randomized controlled trial comparing scarf to chevron osteotomy in hallux valgus correction. Foot Ankle Int. 2016;37(7):687-95.
28. Hawson ST. Physical therapy post-hallux abducto valgus correction. Clin Podiatr Med Surg. 2014 Apr;31(2):309-22.
29. Kaufmann G, Sinz S, Giesinger JM, Braito M, Biedermann R, Dammerer D. Loss of correction after chevron osteotomy for hallux valgus as a function of preoperative deformity. Foot Ankle Int. 2019;40(3):287-96.