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ARAŞTIRMA / RESEARCH

Comparison of clinical and radiological outcomes of Lindgren-Turan and Chevron osteotomies in the treatment of Hallux valgus

Halluks valgus tedavisinde Lindgren-Turan ve Chevron osteotomilerinin klinik ve radyolojik sonuçlarının karşılaştırılması

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Abstract

Purpose: The aim of this studywas to evaluate clinical and radiological outcomes of Lindgren-Turan and Chevron osteotomies in the treatment of hallux valgus.
Materials and Methods: This study included 34 patients with hallux valgus who underwent Lindgren-Turan (Group 1, n=16 patients, 20 feet) or Chevron (Group 2, n=18 patients, 20 feet) osteotomy between June 2010 and June 2014. HVA, IMA and DMAA changes and first metatarsal shortening was evaluated in weight bearing AP radiographs. American Orthopedic Foot and Ankle Society (AOFAS) score was used in the clinical evaluation. Also, EQ-5D score was used in the evaluation of health-related quality of life of patients. Visual analog scale (VAS) was used to evaluate subjective pain scores of patients preoperatively and postoperatively.
Results: There was no significant difference between Lindgren-Turan and Chevron osteotomy groups regarding preoperative and postoperative HVA, IMA and DMAA and shortening of the first metatarsus). Also, there was no significant differences between two groups regarding AOFAS and EQ-5D scores.
Conclusion: Both Lindgren-Turan and Chevron osteotomies are useful techniques in the surgical treatment of hallux valgus. Adequate pain relief, osteotomy union, deformity correction and high patient satisfaction rates can be achieved by two techniques.
Keywords:. Hallux valgus, Lindgren-Turan, Chevron, quality of life, clinical, radiological

Öz

Amaç: Bu çalışmanın amacı Halluks valgus tedavisinde Lindgren-Turan ve Chevron osteotomilerinin klinik ve radyolojik sonuçlarını değerlendirmektir.
Gereç ve Yöntem: Bu çalışmaya Haziran 2010 ile Haziran 2014 arasında Lindgren-Turan (Grup 1, n = 16 hasta, 20 ayak) veya Chevron (Grup 2, n = 18 hasta, 20 ayak) osteotomisi uygulanan 34 halluks valguslu hasta dahil edildi. HVA, IMA ve DMAA değişiklikleri ve birinci metatars kısalığı basarak AP radyografilerinde değerlendirildi. Klinik değerlendirmede Amerikan Ortopedik Ayak ve Ayak Bileği Derneği (AOFAS) skoru kullanıldı. Ayrıca hastaların sağlıkla ilişkili yaşam kalitesinin değerlendirilmesinde EQ-5D skoru kullanıldı. Ameliyat öncesi ve sonrası hastaların subjektif ağrı skorlarını değerlendirmek için görsel analog skala (VAS) kullanıldı.
Bulgular: Lindgren-Turan ve Chevron osteotomi grupları arasında preoperatif ve postoperatif HVA, IMA ve DMAA ve ilk metatarsusun kısalması açısından anlamlı fark yoktu. Ayrıca AOFAS ve EQ-5D skorları açısından iki grup arasında anlamlı fark yoktu.
Sonuç: Hem Lindgren-Turan hem de Chevron osteotomileri, halluks valgusunun cerrahi tedavisinde faydalı tekniklerdir. Yeterli ağrı kontrolü, osteotomi kaynaması, deformite düzeltmesi ve yüksek hasta memnuniyet oranları iki teknikle de sağlanabilir.

Anahtar kelimeler: Halluks valgus, Lindgren-Turan, Chevron, yaşam kalitesi, klinik, radyolojik

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INTRODUCTION

Hallux valgus is characterized by lateral deviation of big toe and medial deviation of first metatarsus. It is the most common foot deformity in adults. It affects %2-4 of the population[1]. It has been associated with many intrinsic and extrinsic factors such as shoe selection, genetics, pes planus, hypermobility of first metatarsocuneiform joint and length of first metatarsus[2].

Treatment choice of hallux valgus is considered with physical and radiological examination. In radiological examination hallux valgus angle (HVA), intermetatarsal angle (IMA), distal metatarsal articular angle (DMAA), congruity of metatarsophalangeal joint, length of first metatarsus, angle of first metatarsocuneiform joint, shape of metatarsus head and presence of pes planus and metatarsus adductus are evaluated[3]. Classification is used for general guidance. It is classified according to hallux valgus angle, intermetatarsal angle, and fibular sesamoid displacement. Accordingly, hallux valgus is classified into three categories as mild, moderate and severe[4].

Conservative treatment is generally attempted on mild cases. Surgery is performed on severe and moderate cases and mild cases that are unresponsive to conservative treatment. Surgical treatment includes soft tissue or bone procedures or combinations of both. The most common procedures performed are metatarsal osteotomies. These osteotomies can be reviewed in three groups as distal, proximal and shaft osteotomies. Distal metatarsal osteotomies have obtained a high degree of success for mild deformities (hallux valgus angle <20 degrees and intermetatarsal angle <11 degrees) with proximal osteotomies being reserved for more severe deformities (hallux valgus angles >40 degrees and intermetatarsal angle >18 degrees). Where the Chevron osteotomy technique is well known and accepted worldwide, Lindgren-Turan technique is relatively less-known. This study aims to compare Chevron osteotomy, a technique that is well known and accepted worldwide with the relatively less-known Lindgren-Turan technique[5]. Several modifications of both procedures are defined to get better correction and results, to decrease complications and to increase patient satisfaction[6,7].

In this study we aimed to evaluate clinical and radiological outcomes of Lindgren-Turan and Chevron osteotomies. In this respect we thought we would make explanatory and comparative contributions to the literature with the results of this current study by presenting the experiences from one center.

MATERIALS AND METHODS

A total of 42 patients were operated for hallux valgus deformity between June 2010 and June 2014 in Erciyes University Faculty of Medicine, Orthopedics and Traumatology Department. Of these 34 patients with mild-to-moderate hallux valgus without degenerative arthritis, didn't receive any operation for hallux valgus before, have pain or trouble putting on shoes or both and cosmetic complaints were included in the study. Patients were excluded with degenerative arthritis, previous history of operation from the same foot and the patients who didn't attend the regular follow ups. Patients received a physical examination before the procedure. Anteroposterior and lateral foot radiographs were obtained in routine radiological examination. Intermetatarsal angle (IMA), hallux valgus angle (HVA) and distal metatarsal articular angle (DMAA) was evaluated. Patients who were diagnosed with hallux valgus angle (HVA) of >20° radiologically were considered as hallux valgus deformity.

Patients were divided into two groups as Lindgren-Turan osteotomy (Group 1, n=16 patients, 20 feet) and Chevron osteotomy (Group 2, n=18 patients, 20 feet). After we followed-up patients for post-operative two weeks, patients were allowed to mobilize with a bandage by stepping on their heels. Patients were controlled regularly in the postoperative 6 weeks, 3 months, 6 months and 1 year. X-ray graphs were obtained to evaluate radiological results.

Preoperative and postoperative HVA, IMA and DMAA changes and first metatarsal shortening were evaluated on AP radiographs. American Orthopedic Foot – Ankle Society Score (AOFAS), Hallux Metatarsophalangeal-Interphalangeal Scale was used in the clinical evaluation. EQ-5D quality of life scale was used in the evaluation of health-related quality of life. Visual analog scale (VAS) was used to evaluate subjective pain scores of patients preoperatively and postoperatively. Informed consent was obtained from all the participants. This study was approved by Erciyes University Clinical Researches ethics committee (Date: 30.07.2015, decision number: 2015/343).

Surgical procedure

All procedures were performed by two surgical teams that are experienced in the hallux valgus surgery. Patients received general or spinal anesthesia. Pneumatic tourniquet was applied to thigh on the side of operation. We paid attention to limit tourniquet duration to 90 minutes and tourniquet pressure to 300 mm Hg. Operations were performed with dorsomedial approach with distal chevron osteotomy or an Lindgren-Turan osteotomy distally while patients were in supine position.

First a linear incision was made at the metatarsopharyngeal joint level, then the medial capsule was opened linearly. Following capsulotomy, bunectomy was performed and finally distal corrective osteotomy was performed with a micro-saw. A 3.5 mm Acutrak headless compression screw system (Acumed LLC, Oregon, USA) was used in the fixation of osteotomy site.

Statistical analysis

In the descriptive statistics section, categorical variables were presented as number, percentage, and continuous variables were presented as mean ± standard deviation for normally distributed data and median (minimum-maximum) for data not normally distributed. Distribution of variables were tested with Kolmogorov Smirnov test.

Mann-Whitney U test and independent t test were used in the analysis of quantitative variables. Wilcoxon test was used in the analysis of repeated measures. Chi-square test was used in the analysis of qualitative variables. All analyzes were performed using SPSS version 22.0 software (IBM Corp., Armonk, NY). A p value <0.05 was accepted as statistically significant.

RESULTS

There were no significant differences (p>0,05) between two groups in terms of age, gender, side, type of anesthesia and follow-up duration between both groups (Table 1). Post- and pre-op HVA values of patients in Turan and Chevron groups are given in Table 2. We didn't identify any significant differences between pre- and post-op HVA value changes in Turan and Chevron groups (p>0.05). There was significant decrease in post op HVA values comparing to pre-op HVA values in both groups (p<0.05). Pre- and post-op IMA values of Turan and Chevron groups are shown in Table 3.

There was not any significant difference between pre- and post-op IMA value changes in Turan and Chevron groups (p>0.05). There was significant decrease in post op IMA values comparing to pre-op IMA values in both groups (p<0.05). Pre- and post-op DMAA values of Turan and Chevron groups are shown in Table 4. There was not any significant difference between pre- and post-op DMAA value changes in Turan and Chevron groups (p>0.05). There was significant decrease in post op DMAA values comparing to pre-op DMAA values in both groups (p<0.05) (Figure 1). Pre- and post-op metatarsal length measurements of Turan and Chevron groups are shown in Table 5. There was not any significant difference between preoperative and postoperative metatarsal length measurement changes in Turan and Chevron groups (p>0.05). There was significant decrease in post op metatarsal length measurements comparing to preoperative metatarsal length measurements values in both groups (p<0.05). AOFAS, VAS and EQ-5D quality of life scale scores of Turan and Chevron group are shown in Table 6 and Table 7. We didn't identify any significant (p>0,05) in any evaluation between two groups.

Table 1. Baseline patients' characteristics

		Lindgren-Turan	Chevron	P
Age (mean ±sd)		40.9 ± 12.1	41.1 ± 14.5	0.978
Sex (n-%)	Male	3 18.8%	5 27.8%	
	Female	13 81.3%	13 72.2%	1,000
Side (n-%)	Right	3 18.8%	9 50.0%	
	Left	9 56.3%	7 38.9%	0.752
	Bilateral	4 25.0%	2 11.1%	
Anesthesia type (n-%)	General	9 45.0%	6 30.0%	0,327
	Spinal	11 55.0%	14 70.0%	
Follow-up (mean ±sd)		27.5 ± 12.6	25.8 ± 10.5	0.807

Table 2. Pre- and post-op HVA changes in both groups.

		Lindgren-Turan		Chevron		P
		Mean ± SD	Med(Min- Max)	Mean ± SD	Med(Min- Max)	
HVA	Preop	32.0±6.0	32 (23-42)	31,3±5,8	32(22-45)	0,881
	Postop	19.0±5.3	18(11-31)	18,2±4,9	18(12-29)	0,596
	Preop/postop change	13.0±3.7	13(8-24)	13,2±3,0	14(8-20)	0,682
Change p		0.000		0.000		

Table 3. Pre- and post-op IMA changes in both groups.

		Lindgren-Turan		Chevron		P
		Mean ± SD	Med(Min- Max)	Mean ± SD	Med(Min- Max)	
IMA	Preop	14.0±2.4	13 (12-18)	14,0±2,1	14(11-19)	0,956
	Postop	9.5±1.2	9(8-12)	9,0±1,6	9(7-13)	0,147
	Preop/postop change	4.6±1.8	4(2-7)	5,0±1,6	5(2-8)	0,438
Change p		0.000		0.000		

Table 4. Pre- and post-op DMAA changes in both groups.

		Lindgren-Turan		Chevron		P
		Mean ± SD	Med(Min- Max)	Mean ± SD	Med(Min- Max)	
DMAA	Preop	17.9±8.5	16 (7-34)	18,7±8,0	18(7-35)	0,678
	Postop	11.7 ±6.8	9(5-26)	12,7±5,6	10(7-26)	0,273
	Preop/postop change	6.1±3.8	6(1-13)	5,9±3,7	6(0-14)	0,797
Change p		**0.000**		**0.000**		

Table 5. Pre- and post-op metatarsal length changes in both groups.

		Lindgren-Turan		Chevron		P
		Mean ± SD	Med(Min- Max)	Mean ± SD	Med(Min- Max)	
Length	Preop	57.6±7.1	57 (46-72)	58.7±6.6	58(45-72)	0.482
	Postop	53.6 ±6.9	53 (42-69)	55.4±6.7	54(42-68)	0.323
	Preop/postop change	3.9±2.1	3 (1-8)	3.3±1.1	3(1-5)	0.598
Change p		0.000		0.000		

Table 6. Post-op AOFAS scores in both groups.

	Lindgren-Turan		Chevron		P
AOFAS	Mean ± SD	Med(Min- Max)	Mean ± SD	Med(Min- Max)	
Total	72.9±16.7	70 (42-100)	72.9±15.4	71 (47-95)	0.935
Pain	31.5 ±8.1	30 (20-40)	31.0 ±7.9	30 (20-40)	0.829
Function	29.7±6.4	27 (22-45)	31.4±6.1	30 (22-40)	0.333
Sequence	11.8±4.4	15 (0-15)	10.8±4.3	8 (0-15)	0.382

Table 7. EQ-5D quality of life scale score and VAS score in both groups.

	Lindgren-Turan		Chevron		p
	Mean ± SD	Med(Min- Max)	Mean ± SD	Med(Min- Max)	
EQ5D TOT	0.7±0.2	0.8 (0.1-0.9)	0.7±0.3	71 (47-95)	0.783
VAS	79.3 ±14.8	83 (45-100)	74.0±17.9	75 (40-100)	0.312

DISCUSSION

The most important findings of this study were that Lindgren-Turan and Chevron osteotomies provide similar and adequate radiographic correction, functional outcome and quality of life improvement in the treatment of hallux valgus. In the literature, average correction rates of HVA and IMA angles are 15° and 5,2° in soft tissue procedure, 13,5° and 3,5° in Chevron osteotomy, 10°-25° and 5°-10 in Mitchell osteotomy, respectively [1]. Average correction rates of HVA and IMA were 13° and 4° in Turan group and 14° and 5° in Chevron group, respectively; thus in accordance with the literature.

Most common post-operative complication of Turan osteotomy is metatarsalgia due to shortening in metatarsus. In our study average shortening value of metatarsus was 3.9 mm in Turan group and 3.3 mm in Chevron group. These shortening values were in accordance with the literature and we didn't observe any metatarsalgia in any of patients.

First metatarsal shortening after distal Chevron osteotomy is reported as 2-2.5 mm in two series [8,9]. Pring reported an average of 6 mm shortening in his series consisting 28 cases [10]. Yücel et al. reported that there was no significant correction in DMAA values of patients after Turan osteotomy [11]. Saro et al. also reported that there was significant correction in distal metatarsal joint angle after Turan osteotomy [12]. Brodsky suggested that there would be no decrease in this angle without additional surgical intervention such as medial wedge removal during osteotomy, and results of Saro et al. originate from an error of measurement technique[12,13]. In the study of Bostan et al. a statistically significant decrease was observed in DMAA with Turan osteotomy[14]. Even without an additional diverter surgical intervention in coronal plane of distal metatarsal joint suggested by Brodsky, after lateralization of distal metatarsal fragment first metatarsus axis shifts to lateral comparing to pre-op position and thus decrease DMAA[14]. In our study we found an average of 6,1° and 5,9° correction in DMMA values of Turan group and Chevron group respectively.

In our study we observed significant radiological decreases in HVA and IMA in patients of Turan and Chevron groups. We observed that higher correction of HVA and IMA in Turan group, and think that it is caused by more lateral shifting, however statistically there was no significant difference between two groups. In our study we observed that if IMA is high residual deformity persists more and this results to dissatisfaction of patients. Nevertheless, previous reports advocate that successful results are obtained with high IMA[15].

Most serious complication after Chevron procedure is avascular necrosis of first metatarsus head [16]. Meier and Kenzora reported %20 avascular necrosis rate in 60 feet that were operated with Chevron osteotomy [17]. This ratio increases to %40 if tenotomy is performed. Coughlin reported that avascular necrosis risk increases after lateral relaxation[16]. Excessive advance of crown saw to lateral might damage first metatarsal artery and lateral capsular circulation that supply head of metatarsus[1]. Because there is no intervention to lateral soft tissues in original technique of Turan osteotomy, avascular necrosis possibility is lower. There is no reported avascular necrosis after Turan osteotomy[8,12]. Yücel et al. reported that they performed osteotomy under fluoroscopy not to cause any damage in lateral soft tissues[12]. We also didn't observe avascular necrosis in any patient.

Turan and Chevron techniques are very popular in the surgery of hallux valgus in our country and there are many reports about this subject. High correlation of clinical, radiological and functional evaluations with personal satisfaction reveal the true success of surgical treatment. Excellent results on angular values might not be satisfying for patients. One should aim to protect joint mobility of first MTF joint and continuity of carrying capacity of forefoot in surgical operations[18]. Patients expect relief of pain, better cosmetic appearance and better function of foot and especially toe. Best predictor of patient satisfaction is the expectancy of patient[19]. Tai et al reported that expectancies of patients differ from surgeons' and depend on patient age and gender[20].

In our study we evaluated personal satisfaction of patients with EQ-5D general quality of life scale. Different quality of life scales give different results and different evaluation techniques cannot be compared precisely[21]. EQ-5D is a general evaluation tool non-spesific to any condition. It provides a general picture of individual's health condition, and is not specific to foot problems. As well as our results are in accordance with the literature, we also didn't find any differences between Turan and Chevron osteotomy groups in post-op quality of life assessment. Saro et al. evaluated their patients who received distal metatarsal osteotomy with AOFAS and EQ-5D questionnaire and found no difference

between two questionnaire results[13].

Esemenli et al[22] reported %80 very good, %16 good and %4 bad result according to Bonney and Macnab criteria. Tatar et al[8] reported %81.1 very good, %13.6 good and %4.6 bad results according to satisfaction level. Ertürer et al reported %62.5 perfect, %29.2 good and %8.3 unsuccesful result according to Moeckel scoring system[23]. We used AOFAS, Hallux Metatarsophalangeal-Interphalangeal Scale to asses clinical and functional results of our patients. AOFAS scores of patients in their final visit were 72,9 ±16,7 and 72,9 ± 15,4 in Turan and Chevron groups, respectively. While these results were in line with the literature, there was no significant differences between two groups. The limitation of this study was that the surgical time, distal part lateralization and sesamoid correction were not calculated in both groups.

In conclusion, although Lindgren-Turan osteotomy was relatively more metatarsal shortening than chevron osteotomy, there was no clinically and radiological significant difference between the methods.

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