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Comparison of modified Lindgren-Turan operation and proximal crescentic osteotomy combined with distal soft tissue procedure in the treatment of hallux valgus

Halluks valgus tedavisinde modifiye Lindgren-Turan ameliyatı ile proksimal kresentik osteotomi ve distal yumuşak doku prosedürü kombinasyonun karşılaştırılması

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Objectives

We compared the results of moderate hallux valgus deformities managed with modified Lindgren-Turan (MLT) osteotomy and proximal crescentic osteotomy combined with distal soft tissue procedure (PCO-DP).

Patients and methods

Twenty-three feet of 18 patients (3 men and 15 women) with moderate hallux valgus deformity were treated between 2003 and 2006. Fourteen feet of 10 patients were treated by MLT and 9 feet of 8 patients were treated by PCO-DP. Radiographic evaluation included measurements of hallux valgus angle (HVA), intermetatarsal angle (IMA), distal metatarsal articular angle (DMAA), medial sesamoid position, metatarsophalangial arthrosis, shortening of the first metatarsal and metatarsophalangial subluxation. AOFAS score was used in the clinical examination. The mean follow-up period was 27.3 months (range 9 to 43 months) for MLT group and 25.2 months (range 6- 40 months) for PCO-DP.

Results

Preoperative and postoperative mean AOFAS scores of modified Lindgren-Turan group were 41.5 and 87.8, respectively ($p<0.001$). Preoperative and postoperative mean AOFAS scores of PCO-DP were 51.9 and 91.1, respectively ($p <0.001$).

Conclusion

Radiological and functional results of modified Lindgren-Turan osteotomy and proximal crescentic osteotomy combined with distal soft tissue procedure in the treatment of moderate hallux valgus deformity revelead similiar results. Thus, we suggest that modified Lindgeren-Turan osteotomy may be a preference by the reason of easier surgical technique with a single incision.

Key words: Hallux valgus, metatarsal osteotomy, distal soft tissue.

Amaçlar

Orta dereceli halluks valgus deformitelerinde modifiye Lindgren-Turan yönteminde (MLT) proksimal kresentik osteotomi ile birlikte distal yumuşak doku girişiminin (PKO-DP) sonuçlarını karşılaştırtırdık.

Hastalar ve yöntemler

Orta dereceli halluks valgus deformitesi olan 18 hastanın (3 erkek, 15 bayan) 23 ayağı 2003 ve 2006 yılları arasında tedavi edildi. 10 hastanın 14 ayağı MLT ve 8 hastanın 9 ayağı PKO-DP ile tedavi edildi. Radyolojik değerlendirmede halluks valgus açısı (HVA), intermetatarsal açı (İMA), distal metatarsal eklem açısı (DMEA), medial sesamoid pozisyonu, metatarsofalangial artroz, 1. metatars kısalığı ve metatarsofalangial subluksasyon ölçüldü. Klinik değerlendirmede AOFAS skoru kullanıldı. MLT grubunda ortalama takip süresi 27.3 ay (dağılım 9-43 ay) ve PKO-DP grubunda 25.2 ay (dağılım 6-40 ay) idi.

Sonuçlar

Modifiye Lindgren Turan grubunda ameliyat öncesi ve ameliyat sonrası ortalama AOFAS skorları sırasıyla 41.5 ve 87.8 idi. PKO-DP grubunda ameliyat öncesi ve ameliyat sonrası ortalama AOFAS skorları sırasıyla 51.9 ve 91.1 idi.

Çıkarımlar

Sonuç olarak orta dereceli halluks valgus deformitesinin tedavisinde modifiye Lindgren-Turan ameliyatı ile proksimal kresentik osteotomi ve distal yumuşak doku girişiminin işlevsel ve klinik sonuçları benzerlik göstermektedir. Bundan dolayı modifiye Lindgren-Turan ameliyatı tek insizyonla yapılan daha kolay cerrahi olduğu için tercih sebebi olabilir.

Anahtar sözcükler: Halluks valgus, Metatarsal osteotomi, Distal yumuşak doku.

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Hallux valgus is the static subluxation of the metatarsophalangial joint. This static subluxation results in lateral deviation of the great toe and medial deviation of the first metatarsal bone.[1] Shoe wear is an important etiological factor in the development of static deformities.[2] Most of the cases reveal subluxated metatarsophalangeal joint which is named as hallux valgus with incongruent joint. Foot deformities with hallux valgus angle (HVA) greater than 15˚ and intermetatarsal angle (IMA) greater than 9˚ on standing weight bearing roentgenograms is termed as hallux valgus. More than 130 operation techniques have been described for the treatment of hallux valgus.[3] The high number of surgical techniques reveals that there is no single way to treat the deformity. Hallux valgus deformities with HVA greater than 30˚ and IMA greater than 12˚ can be managed with a first metatarsal osteotomy.[4]

In the present retrospective study, we aimed to compare short term radiological and functional results of hallux valgus deformities treated with proximal crescentic osteotomy combined with distal soft tissue procedure and modified Lindgren-Turan osteotomy.

PATIENTS AND METHODS

Twenty-three feet of 18 patients (3 male and 15 female) with hallux valgus deformities were treated between 2003 and 2006. Fourteen feet of 10 patients were treated with the modified Lindgren-Turan (MLT) osteotomy (Figure 1). Nine feet of 8 patients

Figure 1. (A) Preoperative and (B) postoperative radiographies of a 28 year old female patient treated with the modified Lindgren-Turan (MLT) operation.

were treated with the proximal crescentic osteotomy combined with a distal soft tissue procedure (PCO-DP)(Figure 2).

MLT operation is performed through an anteromedial 5 cm skin incision over the metatarsophalangeal joint. The capsuloperiosteal racquet shaped flap with a base at the proximal phalanx was elevated and the

Figure 2. (A) Preoperative and (B) postoperative radiographies of a 37 year old female treated with proximal crescentic osteotomy combined with distal soft tissue procedure (PCO-DP).

bunionectomy was performed (in the original technique the bunionectomy is not performed). At the base of the metatarsal head, a transverse line is marked and osteotomy at an inclination of 30˚ to the transverse line is performed. The distal fragment is displaced laterally and fixed with a 3.5 mm screw. Following fixation, flap plication is performed. In the PCO-DP, the first incision is made between the first and the second metatarsal. The adjacent tendon, the lateral metatarsophalangial joint capsule and the transverse intermetatarsal ligament are released. The second incision is centered over the medial eminence. Exposure of the metatarsophalangial joint and bunion lead to the removal of the bunion. The third incision is made over the proximal dorsal aspect of the first metatarsal that deepens to the bone through the medial of the extensor hallucis longus tendon. Osteotomy is performed 1.5 cm distal to the metatarsal cuneiform joint with a crescentic blade and fixed with a 3.5 mm screw.

The mean age in the MLT group was 40 years (range 16-62) and mean follow up was 27.3 months (range 9-43 months). The mean age of the PCO-DP group was 39.62 years (range 26-50) and the mean follow up was 25.2 months (range 6- 40months). Demographic findings were similar in both groups. All patients walked with crutches by weight bearing as tolareted at the postoperative second day with custom made special shoes. Radiographic evaluations and AOFAS scores were obtained preoperatively and postoperatively at the last follow up. Radiographic evaluations consisted of the following measurements: (1) Hallux valgus angle (HVA), (2) intermetatarsal angle (IMA), (3) distal metatarsal articular angle (DMMA), (4) position of the medial sesamoid (MSP), (5) metatarsophalangial joint arthrosis, (6) shortening of the first metatarsal, and (7) metatarsophalangial joint subluxation (MPS).

HVA was measured according to Miller et al. Briefly, the metatarsal reference line was drawn from the center of the first metatarsal head to the base of the first metatarsal and a longitudinal line was drawn through the center of the proximal phalanx. The angle between these two reference lines was measured as HVA[5]. Medial sesamoid position was evaluated according to Smith et al.[6] Metatarsophalangial joint arthrosis was graded according to Mann et al as; (1) Grade 1 mild sclerosis, (2) Grade 2 sclerosis and joint space narrowing, (3) Grade 3 joint space narrowing and osteophyte or cyst formation, and (4) Grade 4 total obliteration of the joint space[7]. Shortening of the first metatarsal was measured according to the Grace method.[8] MPS was graded on the anteroposterior roentgenogram as (1) Grade 0 no subluxation, (2) Grade 1 subluxation less than 2 mm, and (3) Grade 2 subluxation greater than 2 mm according to Smith et al[6]. Patients were questioned for the (1) location of pain, (2) transfer of metatarsalgia, and (3) satisfaction from surgery. Clinical assessment was made according to AOFAS (American Orthopaedic Foot Ankle Society) scores that evaluate pain, function and alignment (Table 1).[9]

Table I

Hallux Metatarsophalangeal-Interphalangeal Scale (100 Points Total).

Pain (40 points)

- None.....40
- Mild, occasional.....30
- Moderate, daily.....20
- Severe, almost always present.....0

Function (45 points)

- Activity limitations
  - No limitations.....10
  - No limitation of daily activities, such as employment responsibilities, limitation of recreational activities.....7
  - Limited daily and recreational activities.....4
  - Severe limitation of daily and recreational activities.....0
- Footwear requirements
  - Fashionable, conventional shoes, no insert required...10
  - Comfort footwear, shoe insert.....5
  - Modified shoes or brace.....0
- MTP joint motion (dorsiflexion plus plantarflexion)
  - Normal or mild restriction (75° or more).....10
  - Moderate restriction (30°-74°).....5
  - Severe restriction (less than 30°).....0
- IP joint motion (plantarfiexion)
  - No restriction.....5
  - Severe restriction (less than 10°).....0
- MTP-IP stability (all directions)
  - Stable.....5
  - Definitely unstable or able to dislocate.....0
- Callus related to hallux MTP-lP
  - No callus or asymptomatic callus.....5
  - Callus, symptomatic.....0

Alignment (15 points)

- Good, hallux well aligned.....15
- Fair, some degree of hallux malalignment observed, no symptoms.....8
- Poor, obvious symptomatic malalignment.....0

Furthermore all patients were examined in terms of arc structure and lesser toe deformities.

Statistical analysis:

Given as means ± standard error, data were analyzed by using Statistical Package for Social Sciences (SPSS) for Windows software. P-values <0.05 were regarded as statistically significant. Distribution of the groups was analyzed with the one-sample Kolmogorov–Smirnov test. Wilcoxon paired two sample test was used when the distribution of the groups were abnormal. Differences within groups were tested with a paired t-test.

RESULTS

Radiological results:

MLT group: Preoperative HVA, IMA, and DMAA was 32.1˚±8.4˚, 13.9˚±3.2˚, and 19.3˚±6.8˚, respectively, whereas postoperative values were 11.8±4.8˚, 6.4±4.5˚, 9.6±3.9˚, respectively (p<0.001) (Table 2).

Table II

Preoperative and postoperative values in MLT group.

Angle	Preoperative	Postoperative	p
HVA	32.07±8.40˚	11.79±4.80˚	<0.001
IMA	13.86±3.18˚	6.36±4.5˚	<0.001
DMAA	19.93±6.77˚	9.57±3.93˚	<0.001

Postoperative MSP improved one grade in 9 feet and 2 grades in 3 feet except in 2 patients that presented Grade 0. Preoperative MPS were Grade 0 in 3 feet, Grade 1 in 6 feet and Grade 2 in 5 feet, whereas postoperatively all feet were Grade 0 except for 1 foot of one patient. Average shortening of the metatarsals in the MLT group was 3.9 mm (range 3.0 to 5.0 mm). Grade 2 metatarsophalangeal joint arthrosis was detected in 2 feet of two patient.

PCO-DP group: Preoperative HVA, IMA and DMAA was 31.1±8.7˚, 15.3±2.7˚ and 17.8±5.2˚, respectively, whereas postoperative values were 12.8±3.2˚, 8.0±2.7˚ and 12.0±4.8˚, respectively (p<0.001) (Table 3).

Table III

Preoperative and postoperative values in PCO-DP group.

Angle	Preoperative	Postoperative	p
HVA	31.11±8.72˚	12.78±3.23˚	<0.001
IMA	15.33±2.73˚	8±2.69˚	<0.001
DMAA	17.78±5.51˚	12±4.82˚	<0.05

MSP improved at least 1 grade in all feet except for one foot which was Grade 0. Preoperative MPS was Grade 0 in 3 feet, Grade 1 in 4 feet and Grade 2 in 2 feet, whereas postoperatively all feet had Grade 0 MPS except for one foot which was Grade 1.

Average shortening of metatarsals in the PCO-DP group was 3.2 mm (range 2.0 to 4.0 mm). Grade 2 metatarsophalangeal joint arthrosis was detected in both foot of one patient.

Clinical results:

There was no arc anomaly except for one patient with pes planus. Lesser toe deformities were not detected. There was one transfer metatarsalgia in one patient in both groups. These patients were not re-operated and pain relieved with metatarsal pads. Mean preoperative and postoperative AOFAS scores in the MLT group was 41.5 (range 29.0 to 67.0) and 87.8 (range 82.0 to 95.0), respectively ($p<0.001$). Mean preoperative and postoperative AOFAS scores of the PCO-DP group was 51.9 (range 40.0 to 65.0) and 91.1 (range 85.0 to 100), respectively ($p<0.001$).

Delayed union managed by grafting was recorded in one patient in the MLT group. Wound infection was detected in one patient in the PCO-DP group who was treated with antibiotics.

DISCUSSION

Although treatment of hallux valgus is controversial, with appropriate surgical procedures, it is highly possible to get good results. The objectives of hallux valgus treatment should include improvement of pain, rapid union and correction of the deformity.[8] Classification of deformities was made according to a traditional method. According to this method; mild deformities have HVA less than 19.0º and IMA less than 13.0º, whereas moderate deformities have HVA between 20º and 40º and IMA between 14ºand 20˚. Severe deformities have HVA greater than 40˚ and IMA greater than 20˚.[3] All patients in this study had moderate deformities except for two feet. Patients were assigned randomly into the two surgical treatment groups. These deformities (HVA greater than 30˚ and IMA greater than 12˚) can be managed with a first metatarsal osteotomy.[4] The first metatarsal osteotomy can be divided into three subsections such as distal, diaphyseal and proximal osteotomies.[3]

PCO-DP is highly effective in restoring the normal biomechanics of the metatarsophalangial joint.[7] Fixation of the proximal metatarsal crescentic osteotomies in dorsoflexion and shortening causes transfer metatarsalgia of the lesser toes due to inappropriate load disturbance[4,10]. One patient in our group had transfer lesion that was managed with metatarsal pads. Pehlivan et al., reported that proximal oblique crescentic metatarsal osteotomy could control metatarsal head elevation and provides three dimensional correction and transfer metatarsalgia can be avoided.[11] Postoperative immobilizitation is also effective in reducing metatarsal head elevation. Average metatarsal shortening in our PCO-DP group was 3.2 mm which was close to the Mann et al study.[7] Coughlin et al found average correction of 23.0º and 14.4º in HVA and IMA, respectively, and Mann et al., detected 21.0º and 8.0º, respectively.[4,7] We detected 18.3º and 7.3º correction in HVA and IMA, respectively. PCO-DP provides reduction of sesamoids in 80% of the cases.[7] At least one grade improvement in MSP was detected in our cases. There was no hallux varus complication in the PCO-DP group; that was reported to be the most frequent complication of this procedure due to difficulties in achieving balance between medial and lateral soft tissues.[4, 7, 12] Coughlin[4] reported average preoperative AOFAS score as 57 and postoperative as 91. We detected an improvement from 51.9 to 91.1 in the AOFAS score. Okuda et al., suggested that short term results (less than one year) of PCO-DP predicts mid term results (longer than 3 years)[13]. Thus, with a mean follow up with 25.2 months, we suggest that our mid term result were good.

Lindgren-Turan operation is a transvers osteotomy performed at 30º of lateral inclination close to the metatarsal head. Bunionectomy is not performed because bunion is believed to be the result of high pressure and after correction of deformity pressure will be relieved and the bunion will disappear spontaneously.[14] We modified this procedure by adding bunionectomy and medial capsular plication to the classical approach. We suggest that this modification accelerates improvement of pain arising from bunion and contributes to correction of the deformity. Any other modification of this procedure was not reported in the literature. Range of motions of interphalangeal and metatarsophalangeal joints were similar with PCO-DP. This may be attributed to early passive range of motion exercises in the MLT group. Grace et al., reported similar range of motion outcomes between the Wilson operation in which the distal metatarsal osteotomy was utilized and capsular plication is performed, and the Hohmann ostetomy where the capsule is not incised.[8] Lindgren and Turan detected an improvement in HVA and IMA from 25.9˚ to 12.6˚ and 14.7˚ to 9.9˚, respectively.[14] We obtained better correction in HVA and IMA with respect to the Lindgren-Turan procedure (Improvement in HVA and IMA from 32.1˚ to 11.8˚ and 13.9˚ to 6.4˚ was detected, respectively). We attributed a better correction to medial plication. Average metatarsal shortening was 3.9 mm. We observed significant improvement in the MSP. Mangan et al., reported at least 1.5 grade improvement in the MSP with percutaneous distal metatarsal osteotomy[15]. Akman et al., detected reduction of sesamoids in 60 % of cases treated with the Lindgren-Turan osteotomy.[16] Preoperative and postoperative average AOFAS scores

in the MLT group were 41, 5 and 87.8, respectively. Advantages of MLT operation with respect to PCO-DP is as follows: single incision, short operative time, and easy surgical technique.

In conclusion, due to similar clinical (AOFAS scores) and radiological results (HVA, IMA, DMAA, MSP, MPS) of the modified Lindgren-Turan operation and proximal crescentic osteotomy combined with distal soft tissue procedure, modified Lindgren-Turan osteotomy is the procedure of choice with an easier technique in the treatment of moderate hallux valgus deformities.

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