



Evaluation of the Efficiency of Double Osteotomy Technique for Residual Metatarsus Adductus Deformity

Rezidüel Metatarsus Adduktus Deformitesi için Çift Osteotomi Tekniğinin Etkinliğinin Değerlendirilmesi

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ABSTRACT

Aim: The most common congenital foot deformity in the neonatal period is metatarsus adductus. The aim of the treatment is to correct the supination of the tarsometatarsal joints and to provide the correct metatarsal alignment. In this study, the clinical and radiological effectiveness of open wedge medial cuneiform and closing wedge cuboid osteotomies in the surgical treatment of metatarsus adductus is investigated.

Materials and Methods: Twenty-five feet of 17 patients (13 males and 4 females), who had metatarsus adductus deformity and were operated with the combination of open wedge medial cuneiform and closing wedge cuboid osteotomies, were evaluated retrospectively. The etiological factors of the deformities were noted. In the radiological assessment, talus-1st metatarsal and calcaneus-5th metatarsal angles in the AP standing radiographs as well as talus-1st metatarsal angle in the standing lateral radiographs were measured on pre and postoperative periods in all cases. The radiological alterations were evaluated in terms of statistical significance.

Results: Metatarsus adductus deformity was due to pes equinovarus sequelae in 12 of 17 cases. In rest of the cases, the etiological factors were congenital, cerebral palsy sequelae, spina bifida, vertical talus and Charcot-Marie-Tooth disease. All measured radiographical angles were found to be improved in the postoperative period when compared with the preoperative values.

Conclusion: Combination of open wedge medial cuneiform and closing wedge cuboid osteotomies in the surgical treatment of metatarsus adductus deformities gives satisfactory clinical and radiological outcomes. The technique is effective in correcting forefoot adduction and midfoot supination with low complication rates.

Keywords: Cuboid, cuneiform, metatarsus adductus, osteotomy

ÖZ

Amaç: Yenidoğan döneminde en sık görülen konjenital ayak deformitesi rezidüel metatarsus adduktustur. Tedavisinde amaç tarsometatarsal eklemlerdeki supinasyonu düzelterek metatarsal doğru dizilimi sağlamaktır. Bu çalışmada, metatarsus adduktusun cerrahi tedavisinde, küboid kapalı kama ve küneiform açık kama ikili osteotomisinin metatarsal osteotomilere üstün olup olmadığı literatür ile karşılaştırılarak araştırıldı.

Gereç ve Yöntem: Medial küneiform açık kama ve küboid kapalı kama osteotomi kombinasyonu ile opere edilen metatarsus adduktus deformiteli 17 hastanın (13 erkek ve 4 kadın) 25 ayağı retrospektif olarak değerlendirildi. Deformitelerin etiyolojik faktörleri not edildi. Radyolojik değerlendirmede tüm olguların ayakta AP graflerinde talus-1. metatarsal ve kalkaneus-5. metatarsal açıları ile ayakta lateral graflerinde talus-1. metatarsal açıları ameliyat öncesi ve sonrası dönemde ölçüldü. Gerçekleşen radyolojik değişikliklerin istatistiksel olarak anlamlı düzeyde olup olmadıkları ve düzelme klinik olarak değerlendirildi.

Bulgular: Metatarsus adduktus deformitesi 20 ayakta doğuştan çarpık ayak sekeline bağlıydı. Geri kalan 5 ayakta etiyolojik faktörler konjenital metatarsus adduktus, serebral palsi sekeli, spina bifida, vertikal talus ve Charcot-Marie-Tooth hastalığıydı. Ölçülen tüm radyografik açıların ameliyat sonrası dönemde ameliyat öncesi değerlere göre belirgin bir şekilde düzelmiş olduğu görüldü.

Sonuç: Rezidüel metatarsus adduktus deformitesinin cerrahi tedavisinde medial küneiform açık kama ve küboid kapalı kama osteotomilerin kombinasyonu tatmin edici klinik ve radyolojik sonuçlar vermektedir. Teknik, düşük komplikasyon oranları ile ön ayak addüksiyonunu ve orta ayak supinasyonunu düzeltmede etkilidir.

Anahtar Kelimeler: Küboid, küneiform, metatarsus adduktus, osteotomi

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INTRODUCTION

Congenital metatarsus adductus is the most common congenital foot deformity of the neonatal period¹ and is characterized by adduction and supination of the forefoot compared to the mid and hind feet^{2,3}.

Postural metatarsus adductus, a disorder which resolves on its own without any treatment and for which the most common cause is intrauterine position disorder, and congenital and residual metatarsus adductus deformities can require both surgical and non-surgical treatments⁴⁻⁷. Although the Ponseti method, which is used in pes equinovarus treatment targeting to correct the foot in cavus adductus varus and equinus order, provides adequate improvement in metatarsus adductus deformities, atypical pes equinovarus deformities, pes equinovarus deformities accompanying spina bifida and cerebral palsy diseases, and residual pes equinovarus deformities, surgical intervention is inevitable⁸. The aim of surgery in the metatarsus adductus is to restore metatarsal alignment and to correct supination in the tarsometatarsal joints⁵. Untreated metatarsus adductus deformity is not an acceptable condition because it causes foot discomfort, even without wearing shoes, chronic foot pain, and frequent metatarsal fractures^{9,10}.

We retrospectively reviewed our patients who underwent tarsal osteotomies (cuboid closed wedge, cuneiform open wedge osteotomy) due to residual metatarsus adductus deformity.

MATERIALS AND METHODS

In this study, the interventions concerning people were in compliance with the 1964 Helsinki Declaration and its subsequent sanctions. Informed consent forms were obtained from all patients and their relatives.

Selection and Description of the Cases

Twenty five feet of seventeen patients, who had metatarsus adductus deformity and were operated with the combination of open wedge medial cuneiform and closing wedge cuboid osteotomies, were evaluated retrospectively. Patients with cardiovascular problems who could not ambulate independently by themselves were not included in the study.

All patients were first examined by the orthopedic surgeon. Afterwards, radiologic investigation of both feet was conducted using standing AP and lateral radiographies and Heyman criteria were used to classify the results clinically⁵.

Technical Information

Under general anesthesia, first, a lateral longitudinal incision was made over the cuboid. The peroneal tendons were retracted in the plantar direction. Using a microsaw, a closing wedge

osteotomy with the base on the dorsolateral side was made by calculating the wedge size due to desired correction angle on the preoperative radiographs and the piece was removed under the guidance of fluoroscopy.

Then, a medial longitudinal incision was made on the medial cuneiform. A single osteotomy was performed on the medial cuneiform with a microsaw under the guidance of fluoroscopy.

Lateral cuboid osteotomy was closed and fixed with one or two Kirschner wires. An appropriate size graft taken from the cuboid was placed on the medial cuneiform osteotomy line. One or two Kirschner wires -with an entry point starting from distal end of first metatarsal and going proximally- were used to fix first metatarsal, distal part of cuneiform, the graft and the proximal part of cuneiform in a line. Both sides were adjusted to correct adduction in harmony with each other. The wires were left out of the skin. A below-knee plaster was applied so that no load bearing was allowed.

On the 15th day, a plaster change was performed to reduce edema and wound care. At the end of the first month, the wires were removed, and a second plaster change was performed. The total plaster duration was 3 months.

At the end of the twelfth week, the plasters were removed and the patients were examined. In the postoperative period, standing radiographs and photographs of the patients' feet were taken.

On pre- and postoperative AP radiographs, calcaneus-fifth metatarsal and talus-first metatarsal angles were measured. This gives us an idea of the adductus deformity of the forefoot. On the pre- and postoperative lateral radiographs, lateral talus-first metatarsal angles were measured, which gives us an idea of the supination of the foot¹¹⁻¹⁴.

Pin tract infections, withdrawal of wire and recurrences were the complications that we have looked for.

Statistical Analysis

Descriptive statistics are presented as the mean±standard deviation and frequency (%). The Wilcoxon signed-rank test was used to determine whether there was a difference in the preoperative and postoperative values of the patients. The Kruskal-Wallis H test and the Mann-Whitney U test were conducted between the groups to determine whether there was a difference in preoperative and postoperative angular values according to the operation side (AP talus-first mt, AP calcaneus-fifth mt, and lateral talus-first mt). Analyses were performed using the Statistical Package for the Social Sciences (version 16), and the statistical significance was determined as $p < 0.05$.

RESULTS

Twenty-five feet of 17 patients (13 males and 4 females; bilateral feet in eight patients and unilateral feet in nine patients), who had metatarsus adductus deformity and were operated with the combination of open wedge medial cuneiform and closing wedge cuboid osteotomies, were included in the study. Metatarsus adductus deformity was a congenital deformity in one patient (n=1, 5.9%) and sequelae of pes equinovarus in 12 of the other 16 patients (n=12, 70.6%), of whom four had the following – one cerebral palsy (n=1, 5.9%), one spina bifida (n=1, 5.9%), one congenital vertical talus (n=1, 5.9%), and one Charcot-Marie-Tooth disease (n=1, 5.9%) – which were the causes of the deformity.

The age distribution of the patients was 3-16 years (11±6 years), while the follow-up period was 37-103 months (77±26 months).

While the mean AP talus-1st metatarsal angle was -16.3° preoperatively, it was found to be 1° in the postoperative period. The mean amount of radiological improvement was 17.3° (p=0.039). While the mean AP calcaneus-5th metatarsal angle was 11.2° preoperatively, it was found to be -1.5° in the postoperative period. The mean amount of radiological improvement was 12.7° (p=0.044). While the mean lateral talus-first metatarsal angle was 26.1° preoperatively, it was found to be 11.1° in the postoperative period. The mean amount of radiological improvement was 15.1° (p=0.040). All improvement degrees were statistically significant (Table 1).

Results were clinically classified as perfect, good, fair and unfair according to the Heyman criteria (Table 2).

Preoperative standing anteroposterior X-ray and image showing left metatarsus adductus and normal right foot is seen in Figures 1 and 2.

Postoperative anteroposterior and lateral X-rays showing the correction of metatarsus adductus and fixation of osteotomies with Kirschner wires is seen in Figure 3.

Standing anteroposterior X-ray and image at the last follow up both standing and plantar view after the removal of the plaster and Kirschner wires showing the correction of metatarsus adductus is seen in Figures 4 and 5.

As a result, twenty of the feet were perfect and five of them were good clinically. Both clinical and radiological improvements were achieved in all patients at the end of the follow-up period after the operation. All patients were able to wear custom made shoes and not fully but satisfactorily – except the spina bifida and cerebral palsy patients – were able to run at the end of control period. In these two patients, additional deformities, like hip adduction deformity and knee flexion deformity in the cerebral palsy patient and hypoesthesia of the feet in the spina bifida patient, did not alter the results obtained from surgery. All the families expressed their satisfaction. We did not observe any complications.

DISCUSSION

Although metatarsus adductus deformity was previously defined only as a forefoot deformity^{1,7}, over the years, the deformity has been said to be a midtarsal deformity, not a metatarsal one^{15,16}.

The first step of treatment is to define the location of the deformity in the foot⁵. Böhne⁷ stated that conservative methods, such as plaster and orthosis, were effective and they emphasized that surgery should be performed only when necessary as treatment. Many methods have been described for the surgical treatment of metatarsus adductus. Only medial cuneiform osteotomy¹⁷⁻²⁰, open only⁵ or percutaneous²⁰ metatarsal osteotomy, medial cuneiform and metatarsal

Table 1. Pre- and postoperative angular values of the patients and the degree of improvement

Region	Preoperative angle	Postoperative angle	Degree of improvement	p value
AP talus-first mt	-16.3°	1°	17.3°	0.039
AP calcaneus-fifth mt	11.2°	-1.5°	12.7°	0.044
Lateral talus-first mt	26.1°	11.1°	15.1°	0.040

mt: Metatarsal

Table 2. Clinical evaluation of the feet

	Radiology	Symptom
Perfect	Normal	No
Good	Mildly abnormal	No and no problem expected in the future
Fair	Insufficient correction	No and no problem expected in the future
Unfair	Loss of correction	Problem expected in the future

osteotomy²¹, cuboid closure osteotomy only¹⁴, medial (medial cuneiform) open wedge and lateral (cuboid) closed wedge osteotomies have been described^{6,11-13,16,22-27}, whereas complete subtalar release and Dwyer osteotomies performed in conjunction with other surgical procedures, such as osteotomies, have also been described²⁸.

Yu et al.²⁹ stated that the type of surgery that should be performed should also change according to the age of

the patient, but in our study, we applied the same bilateral osteotomy to our patients, regardless of age.

Although complications such as wound problems in the early and late postoperative periods in patients undergoing bilateral osteotomy, deformity due to early withdrawal of wire, recurrences, and graft lysis were reported, we did not encounter any complications in our patient group in the postoperative period.



Figure 1. Preoperative standing anteroposterior X-ray showing left metatarsus adductus and normal right foot

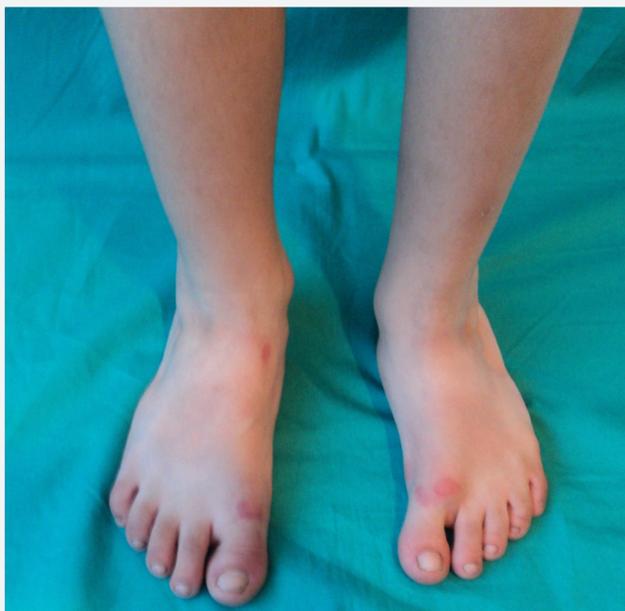


Figure 2. Preoperative view of the patient's feet showing left metatarsus adductus and normal right foot



Figure 3. Postoperative anteroposterior and lateral X-rays showing the correction of metatarsus adductus and fixation of osteotomies with Kirschner wires



Figure 4. Standing anteroposterior X-ray after the removal of the plaster and Kirschner wires showing the correction of metatarsus adductus



Figure 5. a) Standing view of the patient's feet at the last control showing correction of left metatarsus adductus and normal right foot
b) Plantar view of the patient's feet at the last control showing correction of left metatarsus adductus and normal right foot

At the last follow-up, improvement in all three angles were significant and similar when compared with other bilateral osteotomy publications^{6,11-13,16,22-27}. Compared to single osteotomy or metatarsal osteotomy publications, better degrees of improvement were achieved^{5,14,17-21,30}. Although the measurement of the talus-first metatarsal angle on the anterior posterior radiograph is a low reliable angle in terms of observer variability²⁰, the fact that all of the measurements were made by a single person increases its reliability. As stated by Dawoodi and Perera³⁰, proving that there is no hindfoot deformity following anteroposterior talus, first metatarsal angle measurement gives a meaningful idea about each degree of adductus.

Deformities of feet vary and it is important to evaluate them individually and step by step. As Madden and Mahan³¹ stated, deformities must be carefully evaluated before any surgical planning and the goal of surgery should be an improvement in symptoms by creating a controllable foot with a reduction of deforming forces as already done in this study.

Study Limitations

The study is not without limitations. The statistical power of the study is low due to the low number of patients within the cohort. In addition, the short follow-up period is a handicap. Longer follow-up and comparative studies with more patients are needed. The long-term effect of metatarsus adductus on adult feet remains unknown. Publications with long-term follow-up are needed. Comparative publications that evaluate the degree of foot improvement and, if any, recurrence rates after the bone age of patients are completed will give better results.

CONCLUSION

Combination of open wedge medial cuneiform and closing wedge cuboid osteotomies in the surgical treatment of metatarsus adductus deformities is a surgical procedure that can be performed at all ages and is highly satisfactory in terms of correcting forefoot adduction and midfoot supination. It is a reliable method since there is no risk of injury to the physis line. The method is thought to be safe in terms of complication and recurrence rates.

Ethics

Ethics Committee Approval: The study was approved by the Namık Kemal University of Ethics Committee (date: 29/06/2021, no: 2021.174.06.04).

Informed Consent: Retrospective study.

Peer-review: Externally peer-reviewed.

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