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Hallux Valgus of The First Metatarsal Corrected by Proximal Opening Wedge Osteotomy with Low Profile Plate

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ABSTRACT

Background and aim: Corrective procedures for hallux valgus diverse and commonly performed. Proximal osteotomies are increasingly adopted with the opening wedge osteotomy with proximal fixation. Thus, the combination with a distal first metatarsal osteotomy (double osteotomy) and/or proximal phalangeal osteotomy (triple osteotomy) remains feasible. This study aimed to evaluate the outcome of Proximal opening wedge osteotomy of the first Metatarsal for correction of hallux valgus.

Patients and Methods: This study included 30 patients with moderate to severe hallux valgus. They were treated by proximal First Metatarsal Opening Wedge Osteotomy with a Low-Profile Plate at Al-Azhar University Hospital in Damietta. The outcome was assessed on clinical and radiological basis.

Results: Most patients were in their fifties (the age ranged between 21 to 60 years). Males were predominant in both groups (Thirty patients were included. their age ranged from 19 and 30 years (mean age was 22.5±5.4 years). One third of them were males (33.3%). The operative time ranged between 65 and 115 minutes (mean was 95.0±15.0 minutes). The mean duration of postoperative hospital stay was 3.9±1.0 days. The postoperative complications were in the form of infection (6.7%) and recurrence (3.3%) with overall 10.0% complication rate. The final outcome showed statistically significant reduction of HVA, DMMA and IMA, while there was significant increase of AOFAS score (17.0±3.0, 15.2±2.6, 12.0±2.9 and 78.2±6.3 versus 28.0±5.5, 23.9±4.3, 17.2±3.6 and 53.5±7.2 successively).

Conclusion: Proximal opening wedge osteotomy of the first Metatarsal is effective and relatively safe procedure for correction of the hallux valgus.

Keywords: Osteotomy; Metatarsal; Hallux Valgus; Proximal Opening Wedge Osteotomy.

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INTRODUCTION

Hallux valgus (HV) is a common deformity, which characterized by progressive lateral deviation of the great toe at the first metatarsophalangeal (MTP) joint. It is commonly associated with a painful over the soft-tissue prominence. The estimated prevalence of HV is about 23% in adults aged 18 to 65 years. It frequently increased with increasing age and is more prevalent in women and obese subjects. Clinically, it may be presented by foot pain, poor balance, gait disturbances, immobility and increase risk of falling with reduced health-related quality of life [1,2].

The hallux valgus and its corrective procedures are among the most frequent conditions and surgical interventions in the forefoot [3-5].

The operative treatment aimed to correct the deformity and to prevent recurrence with restoration of the biomechanical function of the first ray [6]. The selection of the specific operative procedure depends both on the extent and location of the deformity and on the degree of degeneration of the first (MTP) and metatarsocuneiform joint. A surgeon's preference for a specific technique and the patient's condition may thereby have some impact on decision making as Well [7-9].

Proximal first metatarsal osteotomy is most commonly performed using a proximal closing wedge osteotomy, a proximal chevron osteotomy, or a proximal medial opening wedge osteotomy technique. Since the development of medially placed low-profile locking plates, fixation of proximal first metatarsal osteotomies are more stable mechanically [10-14].

As a consequence, proximal osteotomies are now increasingly performed with the opening wedge technique Osteotomy as well as proximal fixation. Thus, the combination with a distal first metatarsal osteotomy (double osteotomy) and/or proximal phalangeal osteotomy (triple osteotomy) remains feasible [15-18].

This study aimed to evaluate the outcome of Proximal opening wedge osteotomy of the first metatarsal for hallux valgus correction.

PATIENTS AND METHODS

Study design and stetting: This was a quasi-experimental study that included 30 patients with moderate to severe hallux valgus. They were treated by Proximal First Metatarsal Opening Wedge Osteotomy with a Low-Profile Plate. They were selected from Al-Azhar University Hospital (Damietta, Egypt) during the duration extending between April 2021 to Aprile 2023.

Inclusion criteria: Patients with moderate to severe hallux valgus. This was defined by a preoperative hallux valgus angle (HVA) of ≥20 degrees and/or an Intermetatarsal Angle (IMA) of ≥13 degrees. Their age between 19 and 30 years, male or female, with no specific occupations or side of operation.

Exclusion criteria:

Surgery for hallux valgus other than included treatment option or severity of the condition. In addition, to conditions other than idiopathic adult hallux valgus (pes cavus, neuromuscular or juvenile conditions), or first MTP joint degenerative arthritis. Furthermore, other exclusion criteria included clinical tarsometatarsal instability, associated severity comorbidity, previous surgery on the ipsilateral side or denial of participation or absent consent

For data collection, a preformed collection sheet was prepared and the following data were included:

1) results of history and clinical examination (e.g., pain, range of motion (ROM), neurological deficit and postoperative wound infection).

2) Postoperative radiological evaluation (e.g., healing, place of plate and union).

3) preoperative assessment, surgical technique and rehabilitation. In addition, satisfaction of the surgeon and patient were documented. Finally, any postoperative complications and their method of treatment was recorded.

Surgical technique:

The surgical procedure was performed as described previously [19]. Briefly, it consisted of a 3-cm dorsal-medial incision over the base of the first metatarsal bone and another 3-cm one over the medial eminence. The primary modification in the current study was to avoid the first web space release. However, pie-crust the capsule through the joint and release of the dorsal adductor along the lateral sesamoid through the plantar aspect of the joint was performed. An oblique osteotomy was made in the proximal medial metatarsal base. The cut started about 1.5 cm distal to the first metatarsocuneiform (MTC) joint. The cut was then angled so that the lateral apex was positioned approximately 5 mm distal to the first MTC. To provide extra-stability, we performed positioning the apex of the osteotomy in this fashion to permit for the dense soft tissue attachments to cover the apex. The lateral hinge of bone and soft tissue was not disturbed.

Follow-up

Patients were placed in a heel wedge shoe and weight bearing was permitted immediately. Normal footwear was used after six or eight weeks. All patients received postoperative intravenous antibiotics & analgesia. Then, patients were discharged after remaining a febrile for 48 hours with tolerability of normal diet and regaining normal count of white blood cells. The American Orthopedic Foot and Ankle Society (AOFAS) forefoot score was used for clinical evaluation [20]. In addition, HVA, IMA and the distal metatarsal articular angle (DMAA) were calculated and documented [21]. Data were collected when the patients were reviewed at two and six weeks. Then at three, six and

12 months postoperatively. However, preoperative data and data collected at the final follow up (postoperative) were included in statistical analysis (except for infection which calculated directly after operation, during hospital stay or early follow up visits).

Ethical consideration:

The study was completed according to Helsinki declarations code of conduct and reporting of medical research. All patients gave an informed consent for their participation. In addition, their right for withdrawal without any effect on their treatment was guaranteed. The study protocol was reviewed and accepted by the institution review board of Damietta Faculty of Medicine (Al-Azhar University).

Statistical analysis:

All statistical analysis was done using the SPSS version 26 (IBM Corp., Armonk., NY., USA). Continuous normally distributed data were expressed by their mean and standard deviation. Otherwise, the summarization was performed by median and interquartile range (IQR). The normal distribution was examined using the Kolmogorov-Smirnov test. Categorical data were summarized by their absolute frequencies (n) and relative percentages (%). Paired continuous data were compared using the paired "t" test for AOFAS, HVA, IMA and DMAA. P value < 0.05 is considered significant.

RESULTS

The current work was a retrospective collection of data Our study included 30 patients with moderate to severe hallux valgus. **Table (1)** presents demographics and operative data of the study populations. The patient age ranged from 19 and 30 years. The mean age was 22.5±5.4 years. One third of them were males (33.3%) and two thirds were females. The right side was affected in 40.0%, while left side was affected in 60.0%. The operative time ranged between 65 and 115 minutes, the mean time was 95.0±15.0 minutes. The duration of postoperative hospital stay ranged between 2 and 6 days; the mean duration was 3.9±1.0 days. The postoperative complications were in the form of infection in 2 patients (6.7%) and recurrence was reported in 3.3%, leaving the total postoperative complications of 10.0%.

At the final follow up visit, the outcome showed statistically significant reduction of HVA, DMMA and IMA, while there was significant increase of AOFAS score (17.0±3.0, 15.2±2.6, 12.0±2.9 and 78.2±6.3 versus 28.0±5.5, 23.9±4.3, 17.2±3.6 and 53.5±7.2 successively) **(Table 2).**

Table (1): Demographics and operative data of the study population

Variables	Measures	Values (n=30)
Age (years)	Mean±SD	22.5±5.4
	Min.- Max	19-30
Sex (n, %)	Male	10 (33.3%)
	Female	20 (66.7%)
Side (n, %)	Right	12 (40.0%)
	Left	18 (60.0%)
Operative time (minutes)	Mean±SD	95.0±15.0
	Min.- Max	65.0-115.0
Postoperative hospital stay (day)	Mean±SD	3.9±1.0
	Min.- Max	2.0-6.0
Postoperative complication (n, %)	Infection	2 (6.7%)
	Recurrence	1 (3.3%)

Table (2): The main outcomes of study subjects

Variable	Preoperative	Postoperative	P value
HVA° (Mean ± SD)	28.0±5.5	17.0±3.0	<0.001*
DMMA ^{O} (Mean ± SD)	23.9±4.3	15.2±2.6	<0.001*
IMA ° (Mean ± SD)	17.2±3.6	12.0±2.9	<0.001*
AOFAS score	53.5±7.2	78.2±6.3	<0.001*

HVA: Hallux Valgus Angle; IMA: Intermetatarsal Angle; DMMA: The distal metatarsal articular angle. AOFAS: American Orthopedic Foot and Ankle Society (AOFAS) forefoot score. * Significant P Value.

DISCUSSION

The current study presents the author's initial experience with the basal opening-wedge first metatarsal osteotomy with fixation of the osteotomy with a low-profile plate for the correction of symptomatic moderate hallux valgus deformity. Results showed that the majority of our patients were females (66.7%), with age ranged between 19 and 30 years (mean age 22.5±5.4 years). Left side is more affected than the right side (60.0% vs 40.0%, respectively). The mean duration of hospital stay was 95.0±15.0 minutes and 3.9±1.0 days were the mean duration of postoperative hospital stay. Postoperative complications were reported among 10.0% (6.7% for

infection and 3.3% for recurrence). At the end of follow up, the outcome showed statistically significant reduction of HVA, DMMA and IMA, while there was significant increase of AOFAS score (17.0±3.0, 15.2±2.6, 12.0±2.9 and 78.2±6.3 versus 28.0±5.5, 23.9±4.3, 17.2±3.6 and 53.5±7.2 successively). In addition, the plate removal is not reported in our study.

The increased incidence of females in the current work agrees with **Roddy *et al.*** [2] who reported on epidemiology of HV. They reported that, it affects middle age adults, with female sex predilection. In addition, it is widely accepted that shaft and proximal osteotomies are capable of correcting the wide intermetatarsal angle. However, these osteotomies were usually associated with high complication rates, especially due to the difficulty in obtaining stability [22,23]. New technologies and new implants specially designed for foot surgeries appear to present a solution to this problem. Low profile plates and screws are probably turning the proximal opening wedge osteotomy of the first metatarsal into a reliable, predictable and durable procedure [19].

One of the most interesting findings in the current study is the low recurrence rate. This is in contradiction to previous studies. It was reported that, postoperative recurrence remains a significant clinical challenge, regardless of surgical procedure. It was reported in about 25.0% of study subjects [24]. In addition, it is reported that, durable correction of HV depends not only on achieving adequate three-dimensional correction but also on addressing the underlying biomechanical instability of the first ray [25]. The possible explanation of contradictory (heterogenous) recurrence rate may be attributed to definition of recurrence across studies, ranging from radiographic thresholds to clinical symptom-based criteria. **Nery *et al.*** [22] concluded that, proximal opening-wedge osteotomy of the first metatarsal using low profile plates is an effective, secure and reliable method for correcting a moderate or severe Hallux Valgus deformity with high safety profile. This conclusion is in line with the current study. Their study had the advantage of the longer duration of follow up than the current one (2.4 years versus one year).

In addition, **Alturki *et al.*** [26] performed a retrospective case series of 12 consecutive patients (14 feet) treated by open proximal wedge osteotomy using low-profile plate and followed up for a minimum of three years. The overall satisfaction was at 100% of followed patients. Shoe wear and foot shape were improved in 11 feet, and 12 had postoperative pain improvement. Mean preoperative hallux valgus angle (HVA) and intermetatarsal angle (IMA) were at 30.07° and 12.36°, respectively. Postoperatively, the mean HVA and IMA improved to 13.36° and 6°, respectively ($P < 0.001$). All followed patients showed complete healing. They concluded that, opening proximal wedge osteotomy with a LPS fixation is straightforward effective and safe technique. **Saragas** [19] reported that, the HV and IM I---II angles improved by a mean of 14.7 degrees and 6.4 degrees, respectively. The AOFAS forefoot score improved from a mean of 51.3 to 86.8. The mean increase in the length of the first metatarsal was 2.3 mm. Of the more significant complications, five patients developed a hallux varus (early in the series), one of which was symptomatic, and there was one non-union requiring bone graft. They concluded that, the procedure is an effective method for correcting a moderate hallux valgus deformity.

Finally, **Shurnas *et al.*** [27] reported on 90 feet. They showed that, mean preoperative VAS score was 5.9±2.2, compared with a mean postoperative score of 0.5±0.8. The mean 1-2 IMA preoperatively was 14.5±3.3°, compared with postoperative values of 4.6± 2.8°. The mean HVA angle improved from a mean of 30° preoperatively to 10°. There was one nonunion, one delayed union, mild hallux varus in two patients, severe hallux varus in two patients, recurrent hallux valgus in three patients (including the nonunion) and no instances of plate failure. Ninety percent of patients reported good to excellent results after surgery.

The prospective nature and relatively large sample size are the main strengths of the current work. However, the single centre nature and short duration of follow up are the main limitations of the current work. Long term follow up of multicentre studies are warranted. However, the value of the current study is that it adds to the current literature and represented one of the earliest studies treating this topic in our country.

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