ISSN 2618-1584 Vol. 6, Issue 9: 64-68, DOI: 10.25236/FMSR.2024.060910

The influence of BMI on the effect of small incision osteotomy manipulation in the treatment of hallux valgus

Zhang Jin[1], Zhang Le[1], He Linjie[1], Zhao Jun[1], Liu Jian[1]

[1]Xi'an Hospital of Traditional Chinese Medicine, Xi'an, 710021, China

Abstract: *This study selects 30 patients (55 feet) with moderate to severe bunion valgus were treated with small incision osteotomy from October 2022 to October 2023 to observe the effect of BMI in different ranges on the curative effect of small incision osteotomy for hallux valgus. Preoperatively, we complete the basic information of the patient, measure and record the patient's height and weight, take weight-bearing anteroposterior and lateral X-rays of the affected foot before and after surgery, and measure the Hallux Valgus Angle (HVA), Intermetatarsal Angle (IMA) between the first and second metatarsals, the calcaneal pitch angle (CPA), and the distal metatarsal articular angle (DMAA). The American Orthopaedic Foot and Ankle Society (AOFAS) Ankle-Hindfoot Scoring Scale is used for scoring, and the Visual Analog Scale (VAS) is used for pain scoring. The surgical results are as follows: Thirty patients were followed up effectively for 6 months. The first metatarsal osteotomy site in all patients achieved bony union, and the deformity of the toes was corrected. No complications such as metatarsal head avascular necrosis or transfer metatarsalgia occurred in the affected foot postoperatively. By comparing the preoperative and postoperative conditions of patients with different BMI indices, the HVA and IMA were significantly reduced compared to preoperatively, the AOFAS score increased, and the VAS score decreased, with all differences being statistically significant ($P<0.01$). In the patient group with a BMI ≤ 23.9, the changes in HVA and IMA were more significant than in the group with a BMI > 24. According to the experimental results, patients with a high BMI index may have increased body weight postoperatively, which can increase the load on the foot during standing and walking, cause relaxation of the foot ligaments, and compensatory hyperplasia of the bone-bearing parts, affecting the postoperative efficacy of hallux valgus and potentially becoming one of the risk factors for the recurrence of hallux valgus.*

Keywords: *hallux valgus; BMI; Small incision osteotomy*

1. Introduction

Hallux valgus, commonly known as a bunion, is a condition where the angle between the first metatarsal and the big toe is more than 15 degrees, causing the big toe joint to abnormally deviate towards the outside. Hallux valgus is a common foot problem in adults [1], especially in middle-aged and elderly women. The formation of a bunion is a complex and progressive process, starting with deviation of the big toe (hallux) and the first metatarsal towards the inside (metatarsus primus varus) [2], and eventually leading to partial dislocation of the first metatarsophalangeal joint. The causes of bunion formation have been debated for many years, with recognized factors including genetic predisposition, ill-fitting shoes, foot deformities such as hindfoot varus and flat feet [3], excessive physical activity, Achilles tendon contracture, neuromuscular diseases like cerebral palsy and stroke [4-5], and obesity as recently suggested by Jiang Dong in his researches. In a study conducted by Dufour AB and Losina E in 2016, it was found that obesity was not directly correlated with the development of Hallux valgus deformity, but it can increase the incidence of foot pain. Increased body weight leads to increased load on the feet during standing and walking, causing ligament laxity and compensatory bone overgrowth in weight-bearing areas of the foot, thereby increasing the risk of bunion formation. However, the relationship between Hallux valgus and obesity is still not definitively established [6-7]. To further explore the impact of BMI on postoperative outcomes of bunion correction surgery in patients with severe Hallux valgus, a study was conducted from October 2022 to October 2023. Thirty patients (55 feet) with severe Hallux valgus were treated with minimally invasive osteotomy corrective surgery and categorized based on different BMI indices for comparison of postoperative objective indicators. The report is as follows:

ISSN 2618-1584 Vol. 6, Issue 9: 64-68, DOI: 10.25236/FMSR.2024.060910

2. Research Participants and Methods

2.1 Research Participants

From October 2022 to October 2023, 30 cases (55 feet) of moderate to severe hallux valgus patients were treated with a minimally invasive osteotomy technique, including 20 male cases and 35 female cases.

2.2 Diagnostic Criteria

Patients with severe hallux valgus were selected based on the severity of clinical symptoms and bunion imaging examination, according to the consensus classification of Hallux valgus [3].

2.3 Inclusion Criteria

1) Hallux valgus angle (HVA) > 26°, first and second metatarsal angle (IMA) > 16°;

2) Pain and deformity not significantly improved with conservative treatment;

3) Hallux valgus not caused by metabolic bone diseases;

4) Age between 20 and 70 years.

2.4 Exclusion Criteria

1) Asymptomatic Hallux valgus;

2) Patients with mild to moderate Hallux valgus;

3) Patients with foot infections, ulcers, or poor circulation;

4) Patients with deep vein thrombosis;

5) Patients with foot and ankle deformities unable to bear normal weight;

6) Patients with instability of the tarsometatarsal joint.

1) Inclusion Criteria

Patients who meet the diagnostic criteria for hallux valgus. The classification of hallux valgus types is based on the grading standard for the severity of hallux valgus in China. Patients with moderate and severe hallux valgus.

2) Exclusion Criteria

Patients with mild symptoms, gout accompanied by stones in the first metatarsophalangeal joint, and those with other diseases that cannot tolerate surgery.

3) Withdrawal Criteria

①. Patients who voluntarily withdraw after treatment due to perceived ineffectiveness;

②. Patients with poor compliance who fail to follow the treatment plan.

4) Termination of Research Criteria

①. Patients who change to other treatment methods on their own during the treatment period;

②. Patients who voluntarily withdraw or become uncontactable before the end of treatment.

2.5 Methods

2.5.1 Surgical Methods

Doctors use a combination of traditional Chinese and Western minimally invasive osteotomy. Patients are placed in a supine position with both feet slightly beyond the edge of the operating table. The surgical area is routinely disinfected and draped. Local infiltration anesthesia is used. After successful anesthesia, a 0.5 cm incision is made on the lateral side of the first metatarsophalangeal joint

ISSN 2618-1584 Vol. 6, Issue 9: 64-68, DOI: 10.25236/FMSR.2024.060910

to release the lateral joint capsule and soft tissues of the first metatarsophalangeal joint. A small round knife is used to make an approximately 1 cm curved incision on the medial side of the proximal phalanx of the hallux, reaching the phalanx. A small bone periosteal elevator is used to separate the joint capsule between the hallux and the medial metatarsal head from the distal to the proximal end. A grinding drill is used to remove the osteophyte on the medial metatarsal head, and a small bone file is used to smooth the medial side of the metatarsal head without any sharp edges. An incision is made on the medial side of the first metatarsal head and neck, reaching the periosteum, and a grinding drill is used to perform an oblique osteotomy (10-15 degrees) from the distal to the proximal end, with a dorsal to plantar cutting angle of 5-10 degrees. After the osteotomy is completed, the distal metatarsal block is manually pushed outwards from the medial to the lateral side by about one bone cortex, and the distal end of the osteotomy is prevented from moving dorsally, while reducing the dislocated metatarsophalangeal joint and aligning the long and short extensor tendons of the hallux. After the surgery, the incision is irrigated and bandaged, and a traditional Chinese “curtain wrapping method” is used to roll a bandage into a cylindrical pad with a diameter of about 1.5 cm * 5 cm, placed between the 1st and 2nd interdigital web, and the bandage is wrapped in a “figure 8” pattern through the ankle joint, fixing the hallux in an inverted position of 5-10 degrees. Then, a plaster is used to make a semi-“8” pattern from the medial side of the dorsal foot through the 1st and 2nd interdigital web, around the medial side of the foot to the dorsal side of the foot, to strengthen the fixation of the hallux in the inverted position. After fixation, a hand-held X-ray machine is used for fluoroscopy, and manual reduction can be used if the position is not satisfactory until a satisfactory position is achieved.

2.5.2 Observation Index

Based on the height and weight registered by the patients upon admission, the BMI index formula is used to calculate the index of the included patients, and the patients are grouped according to the BMI range value, with BMI ≤ 23.9 and BMI > 24, divided into two groups. The changes in HAV (hallux valgus angle) and IMA (intermetatarsal angle between the 1st and 2nd metatarsal bones) before and after surgery are measured. The American Orthopedic Foot and Ankle Society (AOFAS) scoring standard is used for clinical scoring before surgery and on the 2nd day, 1 month, 3 months, and 6 months after surgery.

2.5.3 Therapeutic Efficacy Evaluation Methods

The American Orthopaedic Foot and Ankle Society (AOFAS) scoring system is used for clinical scoring before and after surgery. Postoperative outcomes are categorized into three levels: excellent, good, and poor.

Excellent: AOFAS score >90 points, free from abnormal gait, complete disappearance of pain symptoms, Hallux Valgus Angle (HVA) <20°, and Intermetatarsal Angle (IMA) <9°.

Good: AOFAS score is between 70-90 points, no pain within walking distances up to 1,000 meters, pain symptoms disappeared, occasional pain under the second and third metatarsal heads during walking, HVA between 20°-25° or IMA between 9°-11°.

Poor: AOFAS score <70 points, persistent pain during walking accompanied by pain under the metatarsal heads, no significant improvement in HVA and IMA compared to preoperative conditions.

2.6 Statistical Methods

Data were processed and analyzed using the SPSS 22.0 statistical analysis software. Quantitative data such as HVA (Hip-Knee-Ankle angle), IMA (Intermalleolar distance), metatarsal span, soft tissue width, VAS (Visual Analogue Scale), and AOFAS (American Orthopaedic Foot and Ankle Society) scores before and after surgery were tested for normality using the Shapiro-Wilk test (W test). Data conforming to a normal distribution were represented in the form of x ±s. Comparisons between preoperative and final follow-up times were made using the paired t-test for quantitative data. A p-value less than 0.05 was considered statistically significant.

3. Results

3.1 General Data

A total of 30 cases (55 feet) were included in the study, consisting of 10 male cases (20 feet) and 20 female cases (35 feet); the age range was 28 to 69 years, with an average age of 56.43 years. The main

ISSN 2618-1584 Vol. 6, Issue 9: 64-68, DOI: 10.25236/FMSR.2024.060910

clinical symptoms were hallux valgus deformity, medial pain and tenderness of the first metatarsophalangeal joint, and the formation of calluses on the plantar surface of the second and third metatarsal heads. Moderate to severe valgus deformity was defined as HVA > 26° and IMA > 16°. Preoperative measurements revealed a severe valgus angle of 36.10° ± 5.97° and an intermetatarsal angle of 14.90° ± 3.19°. The study employed a self-control design before and after surgery. Among the 30 cases (55 feet) of patients, follow-up was conducted for 6 months after surgery. All patients' incisions healed in the first stage, the osteotomy ends healed well, and there were no abnormalities in blood circulation at the toe ends after “curtain wrapping” fixation, no metatarsal head necrosis, no transfer metatarsalgia, and no injury to the deep branch of the superficial peroneal nerve occurred. Postoperatively, the bunion inflammation in the affected feet returned to normal, and there was no discomfort of friction pain during walking. In the two groups, the comparison between the last follow-up and preoperative HVA and IMA significantly decreased in patients with a BMI ≤ 23.9, while in the group with a BMI > 24, the decrease in HVA and IMA was not as significant as in the former group, and the differences were statistically significant (P < 0.01).

Table 1: Comparison of HVA and IMA on X-ray films before and after surgery for the group with BMI ≤ 23.9.

Index	Before surgery	Last follow up	t	P
HVA/(°)	36.10±5.97	11.75±1.96	16.563	<0.001
IMA/(°)	14.90±3.19	7.88±0.56	7.805	<0.001

Table 2: Comparison of HVA and IMA on X-ray films before and after surgery for the group with BMI > 24.

Index	Before surgery	Last follow up	t	P
HVA/(°)	36.±5.97	11.75±1.96	16.563	<0.001
IMA/(°)	14.90±3.19	7.88±0.56	7.805	<0.001

Preoperative and postoperative VAS and AOFAS score statistical analysis showed that the symptoms of pain in the affected feet were basically eliminated, and the function of the foot was significantly improved. The VAS scores in both groups significantly decreased, while the AOFAS scores were significantly higher than before surgery. The VAS and AOFAS scores in the group with a BMI ≤ 23.9 were both better than in the latter group, and the differences were statistically significant (P < 0.01).

Table 3: Comparison of VAS and AOFAS scores before and after surgery for the group with BMI ≤ 23.9 (x±s)

Index	Preoperative/points	Postoperativfe/ points	t	P
AOFAS score	58.32±8.57	86.74±6.47	12.472	<0.001
VAS score	5.20±1.20	1.30±0.30	6.748	<0.001

Table 4: Comparison of VAS and AOFAS scores before and after surgery for the group with BMI > 24 (x±s)

Index	Preoperative/points	Postoperativfe/ points	t	P
AOFAS score	50.32±7.10	80.70±5.30	10.573	<0.001
VAS score	6.20±1.30	2.30±1.30	5.768	<0.001

4. Discussion

Hallux valgus is a common foot disease in adults, with a high incidence, especially among middle-aged and elderly women. Although hallux valgus can occur in adolescents, the incidence rate in adults is much higher than in minors, and the incidence rate in women is higher than in men. In the research of scholars such as Piqué-Vidal, this ratio is as high as 15:1. Although the formation of hallux valgus deformity is a gradual and complex process, in the early stage, the lateral deviation of the big toe (hallux valgus) and the medial deviation of the first metatarsal (first metatarsal varus), in its later stages, the subluxation of the first metatarsophalangeal joint gradually forms.

The reasons of hallux valgus have been debated for many years, and the main factors recognized by scholars include genetic predisposition, uncomfortable shoes, foot deformities such as heel varus and

ISSN 2618-1584 Vol. 6, Issue 9: 64-68, DOI: 10.25236/FMSR.2024.060910

flatfoot, excessive exercise, Achilles tendon contracture, neuromuscular diseases such as cerebral palsy and stroke, but the correlation between hallux valgus and obesity and occupation (except for ballet dancers) [8] has not yet been conclusively determined.

In traditional Chinese medicine, the concept of "Sinew-skeletal diseases" has always been advocated. In pathological states, the earliest manifestation of tendon diseases can be found in the "***Ling Shu Jing Jin***" chapter, which is roughly summarized as "tension of the sinews" and "slackness of the sinews" [9]. "Tension of the sinews" refers to pain symptoms, and the painful areas are mostly located at the "knot points" of the tendons of the big toe, while "slackness of the sinews" refers to the manifestations of the meridian relaxation and limb weakness. Some scholars believe that the imbalance of the mechanical balance of the sinews is thes pathogenesis of hallux valgus, and they believe that formulating a treatment plan that can effectively improve the mechanical environment of the affected toe may be a future trend in the treatment and prevention of hallux valgus.

5. Conclusion

This study demonstrates that this surgical procedure is effective in the treatment of moderate to severe hallux valgus deformities, and the postoperative clinical indicators can all reach the normal range. In addition, through the self-control analysis of patients with different BMI indices before and after surgery, the HVA and IMA were significantly reduced compared to before surgery (Table 1, Table 2), the AOFAS score was increased, and the VAS score was decreased compared to before surgery, with statistically significant differences ($P < 0.01$) (Table 3, Table 4). The changes in HVA and IMA in the patient group with BMI ≤ 23.9 were more significant than in the BMI > 24 group. Although this study has confirmed that the BMI index affects the therapeutic effect of moderate to severe hallux valgus patients, due to the small number of cases included and the short follow-up time, it is necessary to further expand the number of cases and extend the follow-up time to evaluate its long-term efficacy.

References

[1] Jung HG, Kim TH, Park JT, Shin MH, Lee SH. Proximal reverse chevron metatarsal osteotomy, lateral soft tissue release, and akin osteotomy through a single medial incision for hallux valgus. Foot Ankle Int. 2014; 35(4):368- 373.

[2] Tenenbaum SA, Herman A, Bruck N, Bariteau JT, Thein R, Coifman O. Foot width changes following hallux valgus surgery. Foot Ankle Int. 2018; 39(11):1272-1277.

[3] Mann R A, Coughlin M J. Hallux valgus--etiology,anatomy,treatment and surgical considerations [J].Clinical orthopaedics and related research, 1981, 157: 31-41.

[4] Pique-Vidal C, Sole M T, Antich J. Hallux valgus inheritance: pedigree research in 350 patients with bunion deformity [J].The Journal of foot and ankle surgery: official publication of the American College of Foot and AnkleSurgeons, 2007, 46(3):149-54.

[5] Caitlin K. Gribbin et al. Relationship of Radiographic and Clinical Parameters with Hallux Valgus and Second Ray Pathology [J]. Foot & Ankle International, 2017, 38(1): 14-19.

[6] Inman V T. Hallux valgus: a review of etiologic factors [J]. The Orthopedic clinics of North America, 1974, 5(1):59-66.

[7] Milnes H L, Kilmartin T E, Dunlop G. A pilot study to explore if the age that women undergo hallux valgus surgery influences the post-operative range of motion and level of satisfaction [J].Foot (Edinburgh, Scotland), 2010, 20(4): 109-113.

[8] Steinberg N, Siev-Ner I, Zeev A, et al. The association between hallux valgus and proximal joint alignment in young female dancers [J].International journal of sports medicine, 2015, 36(1): 67-74.

[9] Cheng Yong, Wang Zhuxing, Tang Chenglin, etc. Investigation on Pathological Mechanism of Meridian Sinew Disease Theory of TCM [J]. Journal of Liaoning University of Traditional Chinese Medicine, 2014, 16(06):101-108. DOI:10.13194/j.issn.1673-842x.2014.06.039.