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UPDATED ANALYSIS AND REVIEW OF HALLUX VALGUS, CLINICAL CASE DESCRIPTION, ETIOLOGY, EPIDEMIOLOGY, PATHOPHYSIOLOGY, CLINICAL EVALUATION, CONCOMITANT DISORDERS, RADIOGRAPHIC APPROACH, IMAGING CLASSIFICATION SYSTEMS, TREATMENT, PROGNOSIS AND COMPLICATIONS

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SUMMARY

Introduction: *Hallux valgus (HV) is one of the most constant pathologies in orthopedics, compromising both soft and bony tissues of the first toe, being more common in women. This deformity is generated by a progressive subluxation in valgus of the metatarsophalangeal joint (MTF) of the first toe and a varus deviation of the first metatarsal.*

Objective: *to detail current information related to hallux valgus, case description, etiology, epidemiology, pathophysiology, history, clinical evaluation, imaging approach, classification, treatment, prognosis and complications.*

Methodology: *a total of 50 articles were analyzed in this review, including review and original articles, as well as clinical cases, of which 37 bibliographies were used because the other articles were not relevant for this study. The sources of information were*

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PubMed, Google Scholar and Cochrane; the terms used to search for information in Spanish, Portuguese and English were: hallux valgus, deformity, foot, metatarsal, bunions.

Results: *Hallux valgus deformity is relatively common, occurring in about 23% of adults aged 18 to 65 years and up to 36% of adults older than 65 years, and particularly in adult women, occurring in up to 30%.*

Conclusions: *Hallux valgus, or bunion, is the valgus deviation of the first orthotic with a varus deviation of the first metatarsal. The establishment of a diagnosis can be made through physical examination, however imaging helps to determine the involvement of the first metatarsophalangeal joint. At the moment there are several surgical techniques developed to restore the deformity. Hallux valgus corrective surgery is effective, presenting high rates of pain relief, deformity correction and patient satisfaction, however it is not free of complications.*

KEY WORDS: *hallux valgus, deformity, foot, metatarsal, bunions.*

INTRODUCTION

Hallux valgus (HV) is one of the most common pathologies in orthopedics, involving both soft and bony tissues of the first toe, being more common in women. This deformity is caused by a progressive valgus subluxation of the metatarsophalangeal joint (MTF) of the first toe and a varus deviation of the first metatarsal. Hallux valgus is considered a multifactorial pathology. As the first toe deviates and pain increases, the affected individual tends to carry a greater percentage of weight on the heads of the lesser metatarsals, thus increasing the possibility of metatarsalgia in these toes, as well as hyperkeratosis or sometimes stress fractures. At the moment there are several surgical techniques developed to fix the deformity, and to alleviate the pain. The most common are corrective osteotomies, soft tissue plasty, resection arthroplasty and arthrodesis(1).

METHODOLOGY

A total of 50 articles were analyzed in this review, including review and original articles, as well as cases and clinical trials, of which 37 bibliographies were used because the information collected was not sufficiently important to be included in this study. The sources of information were Cochrane, PubMed and Google Scholar; the terms used to search for information in Spanish, Portuguese and English were: hallux valgus, deformity, foot, metatarsal, bunions.

The choice of bibliography exposes elements related to hallux valgus; in addition to this factor, a case description, etiology, epidemiology, pathophysiology, history, clinical evaluation, imaging approach, classification, treatment, prognosis and complications are presented.

DEVELOPMENT

Case Description: a middle-aged male is shown who comes to a trauma consultation for presenting protrusion in the big toe of the left foot, generating pain, difficulty in ambulation and discomfort when wearing footwear.

Complementary tests:

- Physical examination was performed, finding limited mobility of the joint, lateral deviation of the big toe, beginning to tuck under the second toe.
- Anteroposterior radiography shows hallux valgus, with metatarsophalangeal angulation, angulation between the first and second metatarsals.
- Laboratory tests to rule out uric acid, diabetes.

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Figure 1. Radiograph of the Patient Previously Mentioned, Showing Hallux Valgus.

Source: The Authors.

Diagnosis: Hallux valgus.

Results: Surgery was performed and treatment with analgesics and anti-inflammatory drugs was not effective. The use of another type of footwear was also recommended. The patient underwent surgical correction of hallux valgus, presenting pain relief and satisfaction with the surgery in the postoperative control; images of the immediate postoperative period are shown below.

Figure 2. Immediate postoperative fluoroscopy of hallux valgus surgery in anteroposterior view of the foot.

Source: The Authors.

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Figure 3. Immediate postoperative fluoroscopy of hallux valgus surgery in lateral foot view.

Source: The Authors.

Conclusion: Hallux valgus corrective surgery is effective, however, the immediate postoperative period is painful for the patient, in spite of that, later the pain decreases presenting high satisfaction rates. The following is an analysis and an updated review of the subject.

Etiology

Although the exact biomechanical etiology of hallux valgus is not well understood, it is known that the medial prominence or bunion is the result of both medial deviation of the first metatarsal as well as lateral deviation and pronation of the hallux. There are some factors that give a predisposition to form hallux valgus, among them are genetics, female sex, age and tight footwear, however there are multiple other contributing factors such as short first metatarsal, first metatarsal in dorsiflexion, rigid or flexible planovalgus foot, equinus gastrocnemius, abnormal foot mechanics, flexible or rigid varus forefoot and hypermobility of the joints. There is bibliography where there is evidence that gouty arthritis, psoriatic arthritis, rheumatoid arthritis predisposes individuals to present the deformity, as well as the literature indicates an increase in the frequency in connective tissue disorders such as Marfan syndrome and Ehlers-Danlos syndrome and also in Down syndrome. Any muscle imbalance in the foot due to cerebral palsy, stroke or myelomeningocele can also lead to hallux valgus. Tight shoes and high heels are also seen as extrinsic predisposing factors to hallux valgus due to increased loading of the first metatarsal and valgus stress on the first MTF joint during gait(2-8).

Pathophysiology

It is currently thought that there is an imbalance between the extrinsic and intrinsic muscles of the foot as well as the ligaments. The first radius is inherently unstable because its stability depends on multiple static and dynamic structures at the first metatarsophalangeal (MTP) and first tarsometatarsal (TMT) joints.It is also thought that the first stage of hallux valgus deformity is the attenuation of the medial supporting components of the first radius, which generates a medial deviation of the first metatarsal and a lateral deviation and pronation of the hallux, presenting a progressive varus deformity at the first TMT joint. The maintenance of the alignment of the first metatarsal is due to the tension given by the peroneus longus laterally and the abductor hallucis muscle medially. The collateral ligaments do not allow movement along the transverse plane at the first MTP joint. As there is increased pressure on the first metatarsal head, the metatarsal will move medially and dorsally. This force increases the hallux angle and worsens with muscle stabilization during gait. Over time these forces push the first metatarsal medially and the hallux laterally, the medial collateral ligament and medial capsule tighten causing it to rupture. The medial prominence at the first MTF joint is due to the increased prominence of the first metatarsal head(4,5,9-12).

Epidemiology

Hallux valgus deformity is relatively common, occurring in about 23% of adults aged 18 to 65 years and up to 36% of adults over 65 years and particularly in adult women occurring in up to 30%. The prevalence is higher in those who wear shoes or heels compared to the barefoot population. Women present the deformity with twice the frequency, when comparing women and men in barefoot populations (4,13).

Concomitant Disorders

Metatarsus adductus: its prevalence is high, it is thought that concomitant metatarsus adductus makes corrective surgical procedures more difficult and presents higher recurrence rates. It is related to increased forefoot adduction, loss of the buttressing effect of the lesser metatarsals and underestimation of the degree of deformity. A comprehensive approach must be taken to properly manage hallux valgus with concomitant metatarsus adductus(14,15).

Hammertoe: has a strong association with hallux valgus. It is usually considered a secondary deformity, because the hallux alters the position of the second toe. This deformity is thought to be due to the long flexor tendon dominating the intrinsic tendons.

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The hallux valgus deformity does not allow normal forefoot function in gait, transferring pressure from the big toe and overloading the lesser metatarsal heads(16,17).

Achilles tendon contracture: there is a relationship between hallux valgus and a higher prevalence of Achilles tendon contracture, because a tight Achilles tendon generates greater forefoot pronation and increases valgus forces in the foot. Therefore, the peroneus longus loses its stabilizing capacity on the first metatarsal in the frontal plane, reducing the stability of the first radius and the medial column of the foot(18-20).

Medial column collapse (flatfoot): there is a relationship between hallux valgus and flatfoot deformity due to the effect on the stability of the medial column. The flat foot generates a greater pronation of the first radius, increasing the load on the medial and plantar aspect of the first radius in heel elevation. Orthotics can be used as a first line of treatment, however, they do not resolve the hallux valgus deformity(21).

Clinical Evaluation

Some of the clinical features of hallux valgus are:

- Pain in the lesser toes from hammertoe-related deformity or transfer metatarsalgia from altered gait patterns.
- Pain in the medial aspect of the forefoot.
- Persistent symptoms despite attempts to modify footwear or activity.
- Significant bulge or prominence on the medial aspect of the forefoot.
- Difficulty with some types of footwear because of the medial prominence at the first MTP joint.

On physical examination, the following should be evaluated:

- Hypermobility of the first radius.
- Varus or valgus of the forefoot/rearfoot.
- Stiffness of the subtalar joint.
- Midtarsal joint stiffness.
- Resting position of the calcaneus.
- Tibial torsion and neutral position of the calcaneus.

The evaluation can be divided into an unloaded and a loaded evaluation.

Non-Weight Bearing: the position of the hallux, with respect to the second toe, should be evaluated in the transverse plane; this can be underlying, overriding or non-contact. Lateral deviation of the MTP may be due to a subluxation of the MTP joint. It is also necessary to analyze the range of movement of the first MTP joint to know the maximum available displacement being the normal plantar flexion of less than 15 degrees and dorsiflexion of 65 to 75 degrees. Subsequently, the first MTP joint is checked for pain and crepitus, and finally the axis of motion is evaluated.

Weight Bearing: the importance of the deformity is usually more noticeable when weight bearing. An increase in hallux abduction should be analyzed, as well as medial prominence, dorsiflexion of the first MTP joint and metatarsal varus. Some complementary laboratory studies can be considered when there is suspicion of systemic or metabolic disease, rheumatoid factor, erythrocyte sedimentation rate, uric acid, antinuclear antibody, C-reactive protein and complete blood count can be requested. If osteomyelitis is suspected, MRI or radionuclide imaging should be considered(4,5).

Radiographic Approach

Usually, a diagnosis can be established by physical examination, but imaging helps to determine the involvement of the first metatarsophalangeal joint. Initially, a simple AP and lateral loading radiograph of the foot is performed. In where a lateral deviation of the hallux can be found in the first metatarsal, being the normal angle of the hallux valgus inferior to 15 degrees and the intermetatarsal angle inferior to 9 degrees. Generally the deviation is generated transversely, however, HV deformity may result in rotation of the hallux. When the severity of the deformity is determined, the most appropriate treatment will be performed(4).

Anteroposterior, lateral and axial projections of the sesamoid under weight bearing of the affected limb should also be obtained. The hallux valgus angle, the intermetatarsal angle 1-2 (IMA) and the distal metatarsal articular angle (DMAA) are measured from the AP view (Figure 4A). The DMAA is the angle created between the distal articular surface and the longitudinal axis of the first metatarsal (Figure 5). It serves to assess the congruence of the first metatarsophalangeal joint, being less than 10 degrees normal(22,23).

Figure 4. Traditional hallux valgus measurements demonstrated on anteroposterior radiographs. Number 1 corresponds to the first-second intermetatarsal angle (IMA); number 2 corresponds to the hallux valgus angle (HVA).

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Source: Ray JJ, Friedmann AJ, Hanselman AE, Vaida J, Dayton PD, Hatch DJ, et al. Hallux Valgus(5).

The axial view of the sesamoids is notable for assessing the position of the sesamoids in relation to the ridges of the first metatarsal head and for assessing sesamoid subluxation or rotation of the first metatarsal. The presence of the "round sign" assesses the shape of the lateral margin of the first metatarsal head on AP radiographs, as well as can be used to assess first metatarsal rotation. Attention should be paid to the first MTF joint for evidence of arthritic changes. Weight-bearing computed tomography (CT) is now emerging as an important tool to provide a three-dimensional analysis of hallux valgus to further elucidate the pathogenesis of the deformity(24,25).

Figure 5. Distal metatarsal articular angle (DMAA), which can be used to assess the congruency of the first metatarsophalangeal (MTP) joint.

Source: Ray JJ, Friedmann AJ, Hanselman AE, Vaida J, Dayton PD, Hatch DJ, et al. Hallux Valgus(5).

Imaging Classification Systems

It can be divided into mild, moderate and severe according to the views:

Anteroposterior: allows measurement of the intermetatarsal angle, hallux abductus angle, metatarsus adductus angle, hallux abductus interphalangeal, hallux rotation and the state of the first MTP joint.

The lateral projection: identifies the position of the first metatarsal whether elevated or in plantar flexion, in addition to the dorsal exostosis/osteophytes.

The lateral oblique projection: allows to recognize the density, uniformity and trabeculation of the bone.

The axial projection of the sesamoids with weight bearing: it aims to find subluxations of the sesamoids and degenerative changes of the crests in the joints(4).

- Grade: Hallux valgus angle (HVA) - Intermetatarsal angle (IMA)
- Normal: less than 15 degrees - 9 degrees
- Mild: 15 to 30 degrees - 9 to 13 degrees
- Moderate: 30 to 40 degrees - 13 to 20 degrees
- Severe: more than 40 degrees - more than 20 degrees

Classical grading methods use the AP view on radiographs to recognize the severity of hallux valgus in the frontal plane according to HVA, IMA and DMAA, varying somewhat according to the literature.

- Normal is defined as HVA <15 degrees, IMA <9 degrees and DMAA <10 degrees.
- Mild corresponds to HVA <20 degrees and IMA <11 degrees.
- Moderate implies an HVA of 20 to 40 degrees and an IMA of 11 to 16 degrees.
- Severe corresponds to an HVA >40 degrees and an IMA >16 degrees.

In addition, a new classification system for hallux valgus has been proposed that takes into account the complex triplanar nature of the deformity, focusing on determining the apex of the deformity using the principle of the anatomical center of rotation angulation or CORA(5).

Treatment

There are surgical and non-surgical treatments, being the latter the ones that are tried first hand, when this fails, the surgical procedure should be chosen. At the moment there is no definitive evidence that conservative treatment is effective, however, the literature still recommends using conservative therapy prior to surgery. It is essential that affected individuals experience wide shoes and braces before considering more invasive alternatives.

The mission of conservative treatment is to control symptoms without correcting the anatomical deformity. Some of the non-surgical treatment alternatives are:

- Orthoses: optimizing alignment and support.
- Medial bunion pads: prevent irritation of the deformity.
- Shoe modification: wide and low-heeled shoes.
- Stretching: improving joint mobility in the affected joint.
- Analgesics: paracetamol and NSAIDs.
- Ice: to reduce inflammation.

If there is no pain control, management is considered to have failed, therefore surgical treatment may be chosen. The indication for surgery is based on the symptoms of pain and gait difficulty. The presence of arthritis and the severity of the deformity support the choice of the most appropriate procedure, since there are more than 150 surgical procedures for the correction of the deformity, however most of them present the basic approaches presented below.

Osteotomy: a cut is made in the first metatarsal bone and it is placed in a less adducted position. The cut differs in position and shape depending on the surgical technique. In Wilson's osteotomy

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a straight cut is used, in V-osteotomy a wedge-shaped cut is made. The site of the cut can be an osteotomy proximal to the base, scarf osteotomy or in the diaphysis and distal osteotomy at the neck. There are studies where V-osteotomy outperforms the other treatment strategies, showing a normal hallux abductus angle at 12 months, with a satisfaction rate of 80%. However, about 61% of individuals presented moderate problems with footwear. Minimally invasive techniques are now gaining popularity. A comparative study between open osteotomy and minimally invasive surgery revealed no significant differences in terms of success rate, however surgical time is decreased and scarring is less in minimally invasive surgery, and similar clinical and radiographic results were also found between the two treatment groups.

Arthroplasty: the mobility of the first MTP joint remains, as long as the pain is improved by replacing the joint with an implant or removing the joint. Hemiarthroplasty can be performed as well as total arthroplasty. Hemiarthroplasty maintains finger length and requires less bone resection. An interpositional arthroplasty is used in people with severe hallux rigidus which helps maintain the range of motion of the joint. The most common arthroplasty is the Keller resection, in which up to half of the proximal phalanx is resected to increase dorsiflexion and decompress the joint. Following Keller arthroplasty surgery, high satisfaction rates of up to 75% and higher rates of total pain relief are found, with 12% showing increased pain.

Soft tissue procedures: the procedure that primarily involves soft tissues is the McBride procedure, which removes the sesamoid of the fibula, generating flexion of the interphalangeal joint, hyperextension of the MTP joint and medial deviation of the hallux. A comparative study between V-tenotomy plus adductor and V-osteotomy alone showed minimal difference in mechanical correction and no difference in patient satisfaction.

Arthrodesis: fuse the MTP joint in the correct position. This is only done with a significantly degenerated joint and with low probability of functional improvement, mostly used in the elderly. About 81% of those operated showed improvement in pain and ambulation. However, there are complications such as pseudarthrosis. Another arthrodesis alternative is the fusion of the first metatarsal-cuneiform joint, which is frequently reserved for cases of hypermobility of the first radius and strongly increased hallux valgus and first intermetatarsal angle. Currently, arthrodesis at this level has been modified to address triplanar hallux valgus deformity with favorable functional results, reduced recurrence rates and early return to weight-bearing activities.

There are few studies evaluating the efficacy of these procedures. However, as surgical techniques have improved, the satisfaction of the affected individual has also improved. Postoperative care is determined primarily by the type of procedure performed. However, a dressing is usually placed at surgery to provide corrective forces. The dressing also compresses the surgical wound to decrease postoperative edema. The weight-bearing status will depend on the procedure and technique, but is usually limited in the first two weeks. Following suture removal, the affected individual can begin range-of-motion exercises and increase weight-bearing activities. Long-term monitoring is aimed at understanding the exact etiology to ensure that the deformity does not recur. Post-surgical patients may benefit from orthotic devices(4,26-30).

Differential Diagnosis

- Morton's neuroma.
- Osteoarthrosis.
- Hallux rigidus.
- Turf toe.
- Gout.
- Freiberg's disease.
- Septic joint.

Prognosis

The general prognosis is good. Individuals in the beginning should perform a trial of conservative treatments, if pain and functionality do not improve, surgery should be chosen. Postoperative recovery depends on the procedure and technique used. In any bone procedure, such as an osteotomy, healing of the complete bone union may take 6 to 7 weeks and may be longer in smokers. Usually the return to work activities can be done between 6 and 12 weeks after surgery. It has been shown that improvement takes up to 1 year postoperatively.

Complications

Post-surgical complications are different according to the procedure and the surgical technique performed. Among the most frequent complications are pseudarthrosis of bone, hematoma, numbness, osteomyelitis, cellulitis, avascular necrosis, hallux varus, limited joint range of motion, bursitis, hammertoe deformity of the second toe, degenerative disease of the metatarsal head, central metatarsalgia, medial dorsal cutaneous nerve entrapment, MTP joint synovitis and recurrence. Similarly, the incidences of recurrence vary according to the procedure and range from 10 to 47%. The etiology is usually multifactorial, however it usually includes poor surgical technique, anatomical predisposition, compliance with post-surgical instructions and medical comorbidities(13,31-34).
Recurrence is the most common complication, with rates around 8% and 78%. Avascular necrosis is an infrequent but devastating complication(35-37).

CONCLUSIONS

Hallux valgus, or bunion, is the valgus deviation of the first orthotic with a varus deviation of the first metatarsal. The establishment of a diagnosis can be made through physical examination, however imaging helps to determine the involvement of the first metatarsophalangeal joint. At the moment there are several surgical techniques developed to restore the deformity. Hallux valgus corrective surgery is effective, presenting high rates of pain relief, deformity correction and patient satisfaction, however it is not free of complications.

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