

Hallux valgus

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rezime Hallux valgus is a complex deformity of the forefoot. Beside the lateral deviation of the first metatarsophalangeal joint angle exceeding 15-20 degrees and intermetatarsalvarus exceeding 8-9 degrees, it is also characterized by extensive changes of the soft tissue arch, sesamoid mechanism and metatarsocuneiform joint. It occurs almost exclusively in humans wearing shoes. Although in some measure it can be treated non-operatively, by corrective separators and inserts, operative treatment is predominant. There are numerous operative procedures aimed at the correction of the deformity and inducing normal biomechanics of the forefoot. There are seven conceptually different procedures starting from simple bunionectomy, through various soft tissue procedures, metatarsal and phalangeal osteotomies, to resection arthroplasty and metatarsophalangeal arthrodesis. All have clear indications, and none of them has advantages over the others. In accordance with the etiopathogenesis of the disease prevention is easy; wearing comfortable shoes.

Key words: hallux valgus, etiopathogenesis, treatment

INTRODUCTION

The first MT joint of the foot is the most complex joint of the forefoot. It is composed of relatively large bones with attachments of the strong intrinsic muscles on the proximal phalanx of the great toe and a complex sesamoid mechanism the of the short flexor tendon. The head of the MT bone has neither muscular attachments nor dynamic stabilizers, which makes it very vulnerable to extrinsic factors, particularly to the action of extrinsic muscles, the long flexor (m.peroneuslongus) and the anterior tibial muscle (m.tibialis anterior).

In addition, the first MT joint is one of the most significant transmitters of body weight bearing onto the surface during walking. Therefore, it is particularly sensitive to

abnormal stress forces that can lead to a deformity of static nature, such as hallux valgus and hallux rigidus leading the joint into an early degenerative disease with all associated consequences.

NOMENCLATURE

Hallux valgus (HV) used to be called bunion, the term derived from the Latin "bunio" meaning turnip. Besides, the term also referred to all other deformities that could be seen in the first MT joint: bursitis, ganglion, edema of the joint, hallux rigidus, proliferative degenerative diseases and other. Today, the word bunion is only used to signify increased medial eminencies of the first MT joint.

The term hallux valgus was first used by Carl Hueter in 1871.¹ to indicate a deformity of the great toe with the following characteristics:

Static subluxation of the first MTP joint, medial deviation of the first MT bone and lateral deviation of the great toe.

Rotatory (pronation) deformity of the great toe

Dislocation of the sesamoid in the tendons of the great toe short flexor (m.flexorhallucisbrevis) due to medial deviation of the first MT bone

Plantar disposition of the great toe abductor tendons (m.abductorhallucis)

Lateral disposition of the tendons of the great toe long flexors and extensors (m. flexor et extensor hallucislongus)

Therefore, HV is a very complex deformity of the forefoot, which beside the deformity of the first metatarsophalangeal joint (MTP) in term of lateral deviation, also involves significant patophysiological changes of soft tissue structures of the foot arch, sesamoid mechanism and metatarsocuneiform joint (MTC). Also, abnormal biomechanics of the foot can be very often detected, followed by contracture of the Achilles tendon, pesplanus deformity of

the foot, as well as other neuromuscular problems, as for instance cerebral paralysis.

ETIOPATHOGENESIS

Hallux valgus deformity is almost exclusively the privilege of people who wear shoes, while it can be only exceptionally seen in the "barefooted". This fact was first recorded in a study by Lam Sim-Fook and Hodgson in 1958, when they reported that even 33% of shoe-wearing people had some degree of HV deformity, while in barefooted population the rate was only 1.9%². In 1981, Kato and Watanabe published a study reporting that hallux valgus deformity was very rare in the Japanese until 1970, i.e. at the time when they used to wear traditional Japanese footwear, wooden clogs with a split between the great toe and the second toe. With increased use of closed shoes the rate of people with HV deformity also considerably increased³. On the other hand, studies by Maclellan from 1966, on New Guinea population⁴, in 1955, by Barnicota in Western Africa⁵, as well as slightly earlier studies by Wells (1931)⁶ and James (1939)⁷, also on the "barefooted" population of Africa and Solomon Islands, showed that in these people HV deformity with varus of the first MT bone (metatarsus primus varus) could be also seen. It is interesting that the deformity, if present, was entirely asymptomatic. These data shed new light on the attitude that HV deformity occurs only in people wearing shoes indicating that there is clearly the presence of some heredity as well. This is also additionally contributed by the fact that the deformity does not develop in all people wearing modern and uncomfortable shoes.

This means that, beside clear extrinsic etiological factors, there are also intrinsic predisposing factors that make feet of some people more vulnerable to uncomfortable shoes, thus contributing to the development of HV deformity, even in those who do not wear shoes. The presence of the deformity in the adolescents or in very rare cases of congenital or juvenile forms, confirm the above hypothesis. However, until today more frequent occurrence of HV deformity in females could not have been explained by hereditary factors. Finally, it should be pointed out that it is doubtless that some intrinsic factors, such as heredity, the presence of other deformities of the foot (pesplanus, MT primus varus, the lack – amputation of the second toe, contracture of the Achilles tendon of any cause, ganglion – cystic degeneration of the medial capsule of the first MTP joint, hyperelasticity of joints and similar) can be associated with hallux valgus deformity. In 1956, Johnston reported that in some cases of HV autosomal dominant heredity with incomplete penetration was proved⁸. Also, numerous authors have reported the viewpoint that pronation of the foot with pesplanus deformity contributes to the occurrence of HV deformity^{9,10}.

PATHOANATOMY

To describe the pathological anatomy of the deformity, it is first necessary to define the normal condition. The angle between the first two metatarsal bones, the intermeta-

tarsal angle (IMT), is normally below 8-9 degrees. The angle between the MT bone and the great toe, the metatarsophalangeal angle (MTP), is normally below 15-20 degrees. If these values are higher, the condition is described as hallux valgus deformity of the foot. In addition, the relationship between tendons and muscles arranged in four layers in the region of the first MT joint – the tendon of the great toe long and short extensors, long and short flexors of the great toe, abductor and adductor of the great toe, can be disturbed; this leads to a disbalance causing HV deformity with a lateral dislocation of the sesamoid, subluxation of the MTP joint, with the resultant uncovariance of the articular surface of the first MT bone head and pronation of the great toe.

DIAGNOSTICS

To pass the diagnosis and obtain the true values of IMT and MTP angles, it is necessary to perform a standard radiography in standing position in AP, lateral and transversal projections of the foot. The distance between the X-ray tube and the plate should be one meter, with X-ray beams reflected under the angle of 15 degrees in AP projection (from forward to backward).

TREATMENT

Treatment of hallux valgus can be non-operative and operative. Conservative methods are reduced to the usage of comfortable shoes. Footwear should be made of soft material, with soft shoe soles and inserts, and deep and wide enough toe boxes to fit the foot comfortably. The use of various toe separators, bunion pads, night inserts and similar orthotic appliances can be of help in relieving discomfort, but have no causal effect on the deformity. The deformity can be corrected and permanently resolved only by operative treatment.

PREOPERATIVE CONSIDERATIONS

During preoperative preparations numerous facts should be taken into consideration based on which the decision on surgical intervention is brought. First, valgus deviation of the great toe should be precisely assessed, as well as varus deviation of the first MT bone, and pronation of the great toe and the first MT bone, which are often associated; also, measuring the value of the intraphalangeal great toe should be done, assessment whether there are and/or to which measure degenerative changes of the first MTP joint, and if there are limitations in its mobility; assessment of the relative length of the first in relation to other MT bones; assessment of the form and mobility of the metatarsocuneiform medial joint (MTC med.); detailed assessment of medial eminence (bunion); precise location of the sesamoid and, finally, evaluation of foot dynamics, intrinsic and extrinsic musculo-tendon balance and synchronization.

The choice of the operative procedure should be made carefully, taking into account all of the above listed facts, which may only appear easy. Namely, operative procedures to treat HV deformity are numerous, even reaching

several hundreds. Regardless of our choice, the following deformities should be resolved: valgus of the proximal phalanx, great toe pronation, medial eminence of the first MT bone head, sesamoid subluxation, and MT primus varus. None of surgeries can resolve all these deformities at once. Therefore, when bringing decision on the choice of operative procedure, we should be guided by the following principles¹¹:

- Correct deformities without residual functional consequences
- Attempt to induce physiological weight bearing on the forefoot
- Retain mobility of the first MTP joint if possible
- To be aware of the fact of possible complications, but with a possibility left open to ensure acceptable result with revision options

Regardless of the type of surgery, the essence of operative treatment should be based on the fact that essential elements of successful correction of the deformity can be brought down to the following: adequate release of contracted structures surrounding the first MT joint; excision of medial eminence of the first MT bone head; correction of valgus deformity of the first MT joint; correction of considerable MT primus varus; correction of any preexisting etiological factors, particularly in the young, such as contracture of the Achilles tendon or hypermobile first ray of the foot. Whenever possible, one should refrain from a considerable shortening or dorsal angulation of the first MT bone, so as to avoid its offloading at weight bearing. This will result in increased weight bearing on other lesser MT bones with painful metatarsalgia, particularly of the second MT bone head.

Operative treatment of HV deformity can be classified into seven categories:

1. Resection of the exostosis
2. Soft tissue procedures
3. Distal metatarsal osteotomies (Mitchel, chevron)
4. Proximal metatarsal osteotomies
5. Resection arthroplasty (Keller)
6. Great toe proximal phalangeal osteotomy (Akin)
7. First MT joint arthrodesis

Resection of the exostosis is the operative procedure implying a simple excision of prominent medial eminence. If isolated, it can be detected only when there is increased medial eminence without considerable valgus of the first MT joint. It is most often indicated in young persons with an initial and mild HV deformity.

Soft tissue procedures are operations applied to correct HV deformity, performed without osteotomy. The original procedure was first described by Silver in 1923. as medial exostectomy, the release of lateral capsular and adductor tendon release with medial capsular reefing¹². Modifications of this surgery were published by McBride three times. The procedure was later on additionally changed by DuVries^{13,14,15,16}.

Indications are not extensive and refer to mild or moderately severe HV deformities, usually below 40 degrees and associated with MT primus varus of 15 degrees or less. The age of patients is not decisive, but only the size

of the deformity. Also, it should be pointed out that nevertheless, these procedures do not exclude the possibility of performing metatarsal or phalangeal osteotomy during surgery. Contraindications include poor vascular status, incongruence and/or progressive arthrosis of the first MTP joint.

Distal metatarsal osteotomies refer to the osteotomy of the first MT bone in the region of the head and/or neck. Today, these procedures are numerous, but all are derived from two basic procedures: Mitchell's¹⁷ and chevron osteotomy (Austin and Leventen)¹⁸

Mitchell's osteotomy is indicated in adults aged below 50 years with a moderate HV deformity. The intermetatarsal angle (IMT) should not exceed 18 degrees.

Chevron osteotomy is indicated in patients aged below 50 years, also including adolescents, with HV deformity up to 30 degrees and the IMT angle up to 15 degrees, but without pronation deformity of the great toe. Also, it is very important to point out that the first MT joint should be congruent. HV deformities exceeding 30-35 degrees with the IMT angle above 15 degrees with joint incongruence and pronation of the great toe can be considered a contraindication to this operative procedure.

Proximal metatarsal osteotomies as a concept exist in two forms: opening wedge osteotomy first described by Bonney and MacNaba in 1952.¹⁹ and closing wedge osteotomy described by Balacescu in 1903²⁰. Indications for this type of osteotomy is HV deformity with the ITM angle exceeding 15 degrees, i.e. when intraoperatively the reduction of the first MT bone cannot be achieved even after an extensive soft tissue procedure. As the length of the first MT bone is of the highest significance for the biomechanics of the forefoot at weight bearing, one of the offered options should be carefully chosen. If the first MT bone is short it should by no means be further either shortened by closing osteotomy or additionally lengthened by opening osteotomy if it was initially long. Perhaps the best solution is to perform the so called crescentic osteotomy which does not change the length of the MT bone; however, it is surgically more challenging.

Resection arthroplasty – Keller's procedure. It was described as early as in 1887. by Davies-Colley²¹, and was some time later popularized by Keller (1904.), after whom it was named²². The goal of this operative procedure is to decrease the forces of weight bearing on the first MTP joint by resection of the proximal one-third of the proximal great toe phalanx and by bunonectomy, thus decreasing problems due to HV deformity. In this manner the ITM angle remains unchanged so that HV deformity can be corrected up to a certain measure only. Although being very popular and often used in the past, today this procedure is regarded adequate only for older patients with minimal functional requirements. Also, it is used as a salvage procedure after failed operative treatment by other surgical procedures.

Toe proximal phalangeal osteotomy was described by Akin in 1925.²³ Besides closing wedge osteotomy of the proximal part of the proximal phalanx, the procedure also involves excision of medial eminence and lateral capsular

release. It is indicated in case of hallux interphalangeal deformity, HV deformity of less than 30 degree and without a considerable MT primus varus. Also, it is a useful procedure for the correction of recurring HV deformities when joint congruence does not allow additional soft tissue procedures or as an additional correction of deformities in conjunction with metatarsal osteotomies. It is applied to sustain the present congruence of the first MTP joint, but without influencing the IMT angle.

First MT joint arthrodesis is the operative procedure used to treat HV deformity was first described by many authors: Broca (1852.), Clutton (1894.), DuVries (1965.), McKeever (1952.)^{16,24,25,26} The purpose of this method is to sustain the length of the first MT bone without weakening the stability of the first ray of the foot. Indications are numerous: progressive HV deformity with joint arthrosis in rheumatoid arthritis, posttraumatic arthroses, conditions after failed arthroplastic procedures, and HV deformity after the loss of the second toe. Also, it is often used as a salvage procedure following failed earlier described corrective procedures. A relative contraindication represents associated interphalangeal arthrosis.

CONCLUSION

Hallux valgus is a highly complex deformity of the forefoot, with lateral deviation of the first MTP and considerable pathophysiological changes of the soft tissue structures of the foot arch, sesamoid mechanism and metatarsocuneiform joint. It occurs almost exclusively in persons wearing shoes, while being very rare in the barefooted and without significant symptoms.

Although, to a certain measure, it is possible to be non-operatively treated using corrective separators, sole inserts and by wearing comfortable shoes, the predominant treatment implies surgery. The number of described operative procedures referring to this disease is probably the highest in orthopedic surgery, and they are all currently in usage. The field of indications is extensive allowing the surgeon to make a choice also based on personal experience and inclinations. None of the offered operative options is ideal and there is no method that is reliably "better" from others. Treatment results are steadily good and permanent.

Prevention is simple and can be brought down only to wearing comfortable shoes before the occurrence of the deformity.

SUMMARY

HALLUX VALGUS

Hallux valgus je kompleksan deformitet prednjeg stopala. Pored lateralne devijacije prvog metatarzofalangealnog zgloba veće od 15-20 stepeni i intermetarzalnog varusa većeg od 8-9 stepeni, odlikuje se i opsežnim promenama u mekim tkivima svoda, sesamoidnom mehanizmu i metarzakuneiformnom zglobu. Javlja se gotovo isključivo kod ljudi koji nose obuću. Iako se donekle može tretirati neoperativno, korektivnim separatorima i ulošcima, dominantno lečenje je operativno. Opisan je veliki broj operativnih postupaka čiji je cilj korekcija deformi-

teta i uspostavljanje normalne biomehanike prednjeg stopala. Postoji sedam konceptualno različitih procedura počevši od jednostavne buniektomije, preko raznih mekotkivnih procedura, metarzalnih i falangealnih osteotomija, do resekcione artoplastike i metatarzofalangealne artrodeze. Sve imaju jasne indikacije i nijedna od njih nema prednost nad ostalima. U skladu sa etiopatogenezaom bolesti prevencija je jednostavna: nošenje udobne obuće.

Ključne reči: hallux valgus, etiopatogeneza, lečenje

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