HALLUX VALGUS AND STATIC AND DYNAMIC POSTURAL COMPENSATION DETECTED ON THE FIRST ASCENDING KINETIC CHAIN

(Study conducted in subjects 65 - 75 years old)

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Summary

A population of elderly people (120 subjects aged between 60 and 75 years), followed in the practice of a motor activity programme aimed at physical fitness, was monitored and subjected to various kinesiological assessment tests (joint mobility, muscle strength, postural harmony) in order to design the right quantity and quality of physical exercise.

Postural tests revealed specific plantar evocation disorders and since 52% of the subjects examined (100 female subjects aged between 65 and 75 years) presented permanent lateral dislocation of the big toe - with an angle greater than 10° - a dimorphism better known as hallux valgus (HV), our study focused on examining 12 female subjects aged 65 to 75 years, comparing differences in plantar projection of body weight distribution in both static and dynamic situations and in stabilometry, in healthy subjects and those with HV.

Key words: Hallux valgus, Stabilometry, Baropodometry.

Summary

One population of elderly practising gymnastic lessons (120 subjects of age ranging from 60 to 75 years), performed tests for kinesiology evaluation (the range of movement, strengh of muscles and postural harmony) to obtain an adequate quality and quantity of physical exercise. The postural tests showed specific foots disorders, 52% of elderly (100 female subjects of age ranging 65 to 75 years) reported permanent lateral dislocation of hallux - with angle more than 10 ° - generally called Hallux Valgus (HV). The study protocol wants to compare the differences between the projection of the distribution of the body weight on the feet and stabilometric evaluation in 12 female participants of age ranging 65 to 75 years with normal and HV foot.

Key words: Hallux Valgus, Stabilometry, Baropodometry

Introduction

Problems with the lower limbs, and in particular the feet, are very common in older people. Foot problems and deformities were found in 50% of 166 geriatric patients. [1] In another study 52% of 543 elderly subjects were found to have the same problems. [2] These dysmorphisms are often accompanied by pain and functional limitation with difficulty and increased fatigue in walking and standing. [3,4] As this syndrome, which induces compensatory adaptations, could also compromise the correct execution of the exercises proposed in the motor activity programme in which the subjects were included, it was considered necessary to investigate certain aspects of this problem.

Many are the afferences that interact for the control of posture and walking, the plantar ones are certainly of primary importance, as the proprioception of the foot determines global postural responses. The information coming from the visual receptors is undoubtedly of great significance, but the information from the plantar cutaneous mechanoreceptors is irreplaceable and determines the postural attitude. [5, 6, 7]

Materials and methods

Specific data collected by means of tests dedicated to posture, stabilometry and baropodometry on 100 elderly people aged between 65 and 75, followed in a wider project of motor activity for physical fitness, have shown that 52% have at least one foot with a malformation of the first metatarsal phalanx (hallux valgus or HV). For this particular study, 12 subjects were selected, 7 with normal feet and 5 with non congenital hallux valgus in both feet. For the acquisition of static and dynamic data, an electronic baropodometer was used, consisting of a module equipped with 1600 active sensors for static and stabilometric evaluation and a module equipped with 4800 active sensors distributed over a 3-meter long surface used for dynamic evaluation using the program called ***PHYSICAL GAIT SOFTWARE* ™** [Fig. 1, 2]. Data collection was carried out at the laboratories of the Faculty of Motor Sciences in Bologna, and the results were analysed and discussed in collaboration with Professor James S. Frank, Director of the School of Anatomy of the Department of Kinesiology at the University of Waterloo.

The tests were carried out without footwear. In the baropodometer tests, walking at normal speed and a static walking posture in a functional position were required.

Fig. 1: Static Baropodometer testFig.2: Dynamic Baropodometer test

Results

- Static-dynamic baropodometry

The first data analysed were obtained by evaluating the weight distribution in g/cm2 of each individual subject on both feet, both of which in turn were divided into 6 portions: 3 medial and 3 lateral. The axis of the foot determined the median line, while the anterior, middle and posterior portions are one third of the length of the foot itself. Each sector was marked with a letter A, B, C for the lateral part of the foot, D, E, F for the medial one. [Fig. 3, 4].

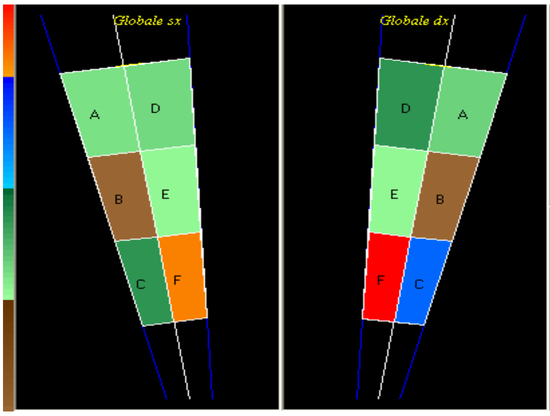


Fig. 3: Graphical representation of mean pressure on both feet in gr/cm2 in normal subjects

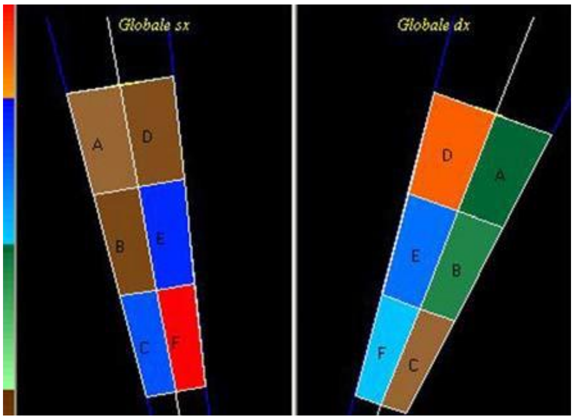
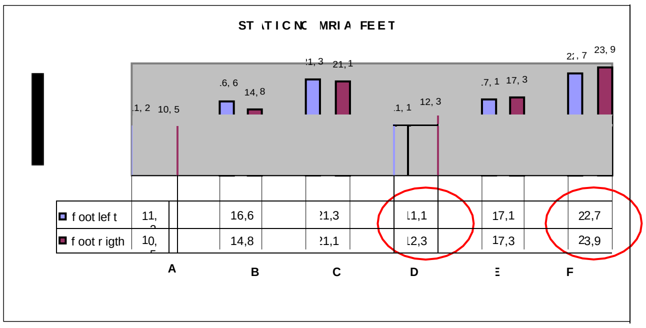


Fig. 4: Graphical representation of mean pressure on both feet in gr/cm2 in subjects with HV

The pressure percentage of each sector was calculated for each subject in relation to the body weight and the average value was found in the two groups, both in static and dynamic situations.

The results show increased pressure in the medial and anterior aspect in both feet in subjects with hallux valgus, in both static and dynamic situations.

The pressure also increases during walking in both groups in the same sector portions. Of particular interest is sector D, which for both feet represents the area of the first metatarsal phalanx. The weight in this area is always greater in subjects with hallux valgus. [Fig. 5, 6, 7, 8].



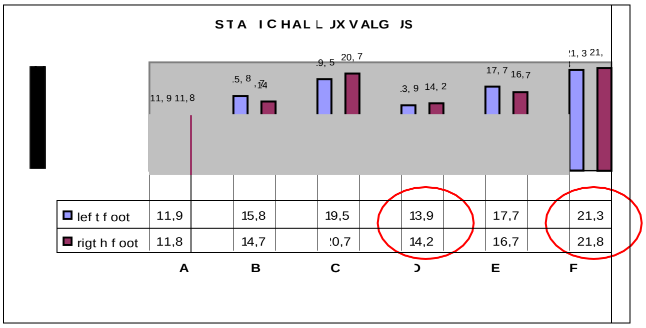
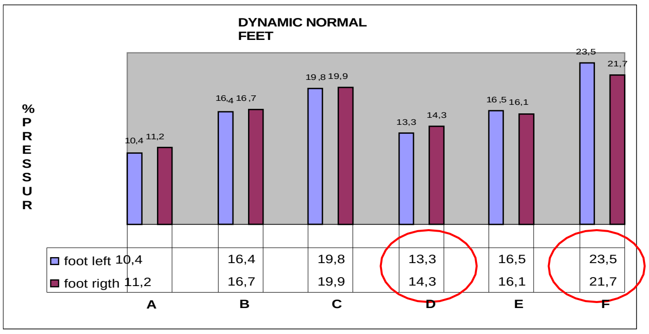


Fig. 5: Average pressure % in static situation with normal feetFig.6: Average pressure % in static situation with HV



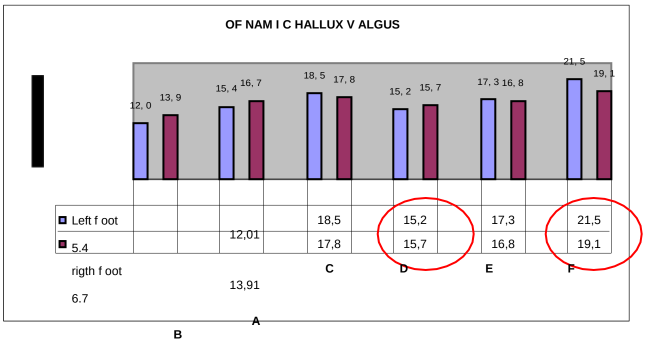


Fig. 7: Average pressure % in dynamic situation with normal footFig.8: Average pressure % in dynamic situation with HV

- Pitch analysis

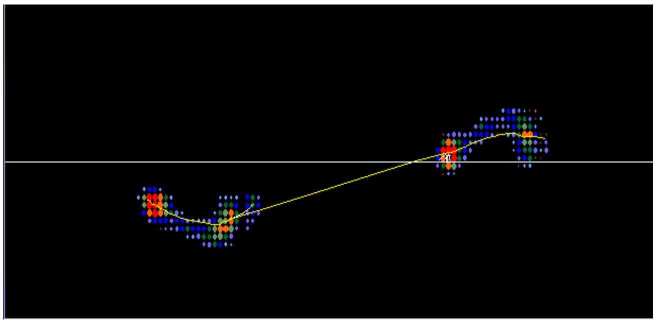
We then examined the double support (moment we calculated in the double anterior stop support) and the total step (sum of the anterior thrust support moment added to the contralateral swing and support moment and the double stop support moment) with length values in cm and time in sec. [8] [Fig 9]

The data collected show a shorter distance in cm from the heel of one foot to the next in normal subjects (44.25 cm) than in those with hallux valgus pathology (52.15 cm). [Fig 10] The data also showed that in HV subjects there was less time in double support compared to the total time required to take a step (the ratio calculated as a percentage showed 22% in normal subjects and 18% in HV). [Fig 11, 12].

In the rolling phase (transition from the attitude of decisive dorsal flexion to maximum plantar flexion), we analysed the time elapsed from the heel strike to the heel position.

(maximum dorsal flexion of the foot) at plantar support - when the load axis falls between the calcaneus and the metatarsal region - of the right foot. In HV subjects, the time is clearly shorter (0.24 sec) compared to people with normal limbs (0.31 sec).

The gait for subjects with HV is therefore characterised by a longer stride, a shorter double support time and a shorter partial rolling time.



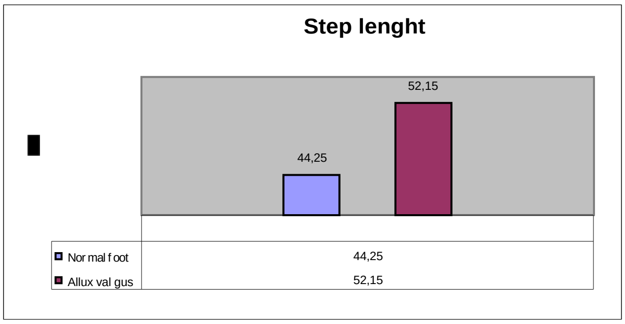


Fig. 9: Screen after completion of testFig.10:

Graphical representation of step length values

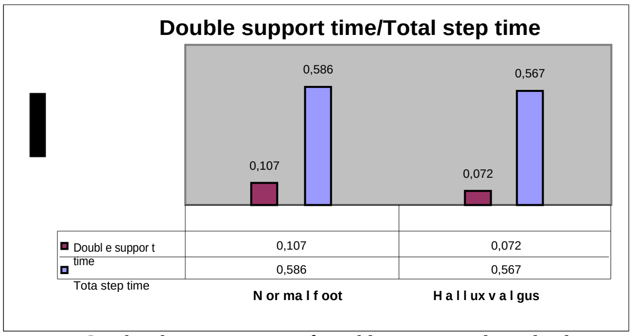


Fig. 11: Graphical representation of Double support and Total values step time

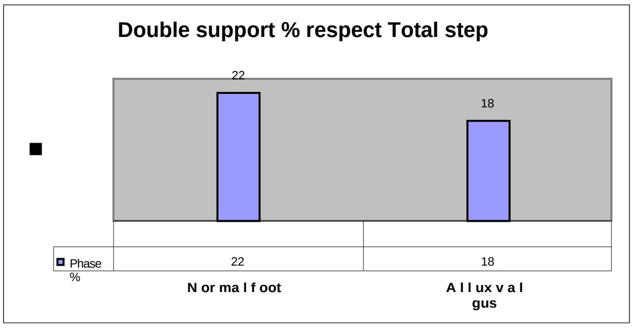


Fig. 12: Graphical representation of Double support values in relation to the Total step

The results on the first 10 seconds of the stabilometric test [Fig. 13, 14], whose total reference duration is 51.2 seconds, were analysed; with regard to the average speed of the centre of pressure (COP) in sec [Fig. 15], the surface occupied by the same in its path (Sup. Elipse), measured in mm2 [Fig. 16] and the length of the ball (Path lenght) in cm. [Fig. 17].

The comparison between normal and HV subjects, shown in the histograms of the average of the data acquired above, shows a decrease in all values in HV.

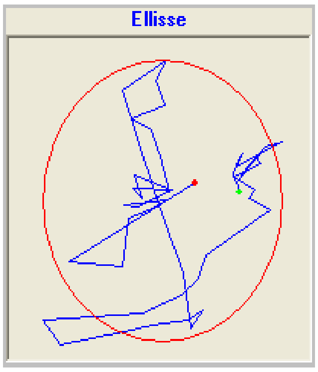


Fig. 13: Stabilometric test in normal subjects

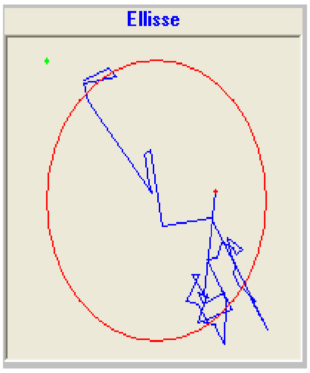


Fig. 14: Stabilometric test example in HV

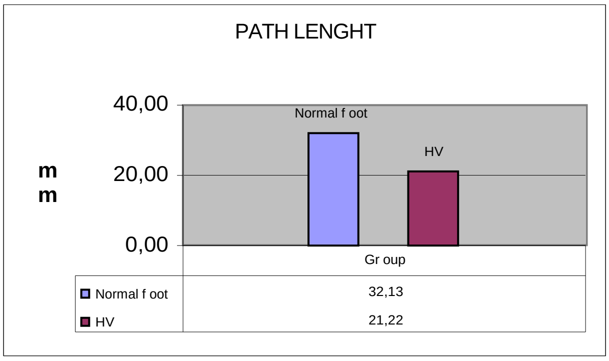


Fig. 15: Graphical representation of the length of the COP

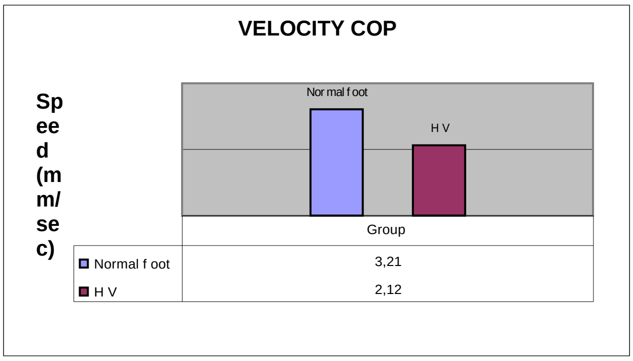


Fig. 16: Graphical representation of COP speed

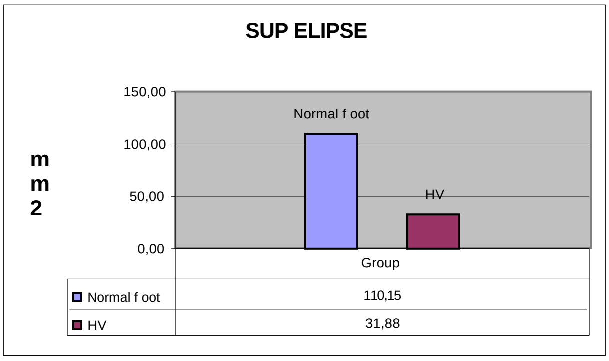


Fig. 17: Graphic representation of the area occupied by the COP

Discussion

The data collected in two small groups of active elderly people who practise motor activity in the gym twice a week show in people with HV, both in static and dynamic baropodometry, greater support in the front and medial part of the foot with overloading in the region of the first metatarsal phalanx; this imbalance presupposes a progressive accentuation of the paramorphism found.

The step is also characterised by a longer step length phase, a shorter double support phase and a shorter partial rolling time. The shorter time elapsing from calcaneal support to plantar support reasonably suggests a decreased dorsal flexion due to the contraction of the anterior loggia of the leg, a phenomenon that

In the HVs, it justifies the increased pitch length to avoid 'stumbling' with the ground in the initial phase of the oscillating time.

The stabilometric data suggest a real static contraction of the myofascial chains of the leg, which are responsible for posture, which determines two factors, one hypo-haematising and one of venous stagnation. The first leads to a decrease in resistance to effort and tends to increase joint damage from chronic microtrauma, the second leads to phenomena of vascular pathology. [9,10,11]

From a kinesiological point of view, the data collected lead us to design a particular motor activity programme, to be included in the more general physical fitness activity plan.

This integration of exercises will tend to recover the correct tonic-perceptual relationship, reharmonising, as far as possible, in the static walking scheme, the balance of the tension-length relationship of the myofascial chains which are at the basis of the ascending postural compensation response (triceps suralis, posterior tibial, peroneri). [12] All this will be aimed at minimising the fatigue of particular muscular districts, the damage of increased static contraction, the diminished functionality of certain muscular districts, in one of the most important aspects of the dynamics of the human body such as walking. The objective will be pursued by inducing with targeted exercises in different postures and attitudes, phasic contractions, for a functional effectiveness of the kinetic chains and for a real capillary gymnastics.

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