MODIFIED CHEVRON OSTEOTOMY: PRELIMINARY ANALYSIS OF BAROPODOMETRIC BEHAVIOR

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ABSTRACT

Objective: To evaluate the clinical and baropodometric characteristics of the gaits of individuals with a hallux valgus deformity after modified Chevron osteotomy, in isolation or in association with the Weil osteotomy. Methods: Foot evaluation was performed before and three months after surgery analyzing 27 mildly and moderately deformed feet. The clinical evaluation included the AOFAS score and radiographic measurements. The baropodometric evaluation was done with the Emed-at platform. Peak of Pressure, Pressure-Time Integral and Relative Load were calculated in 10 different regions of the feet: calcaneous, midfoot, first to fifth metatarsal regions, hallux, second and third to fifth toes. Results: After the surgical procedure, an increase in AOFAS scores and a decrease of radiographic parameters were seen. The baropodometric evaluation, after isolated Chevron osteotomy, showed a reduction in pressure and strength under the first metatarsal and hallux, as well as an increase in the same variables on central and lateral metatarsals. After Chevron/Weil osteotomy significant alterations had only occurred in the region of the hallux and toes. Conclusion: In the short-term, the modified Chevron technique promoted improvements in clinical conditions and radiographic parameters. The baropodometric evaluation evidenced a load transference from medial to lateral regions of the forefoot, possibly due to the short postoperative period.

Keywords: Hallux valgus. Osteotomy. Dermatoglyphics.

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INTRODUCTION

There are countless surgical procedures described in literature to correct hallux valgus (HV) deformity, making the choice of a universal technique difficult.[1,2] The choice of the surgical technique should be based on the ability to correct alignment and to reestablish the pattern of load distribution on the forefoot, without producing residual incapacity.[1] However, although biomechanical systems currently exist that are capable of providing detailed quantitative evaluations of the distribution of loads in specific regions of the foot during locomotion, most studies use only clinical parameters and radiographic measurements to determine the efficacy of different surgical techniques utilized for correction of hallux valgus deformity.[3-8] Therefore, the aim of this study was to evaluate the clinical, radiographic and baropodometric parameters of the gait of individuals with hallux valgus (HV), soon after a surgical procedure of correction by the modified Chevron osteotomy technique, performed alone or in association with the Weil osteotomy.

MATERIAL AND METHOD

The study subjects were 16 women with mild and moderate hallux valgus deformity, mean age 49±13 years (26-64 years), coming from a private Orthopedic Clinic, located in the city of Florianópolis. Bilateral impairment was recorded in 11 patients, totaling 27 feet assessed. All the feet underwent the surgical correction procedure performed by the same team, with modified distal Chevron osteotomy as standard surgical technique.[7] Exclusion criteria were: individuals with diabetes, evidence of other pathologies or previous surgery on the foot and lower limbs, or neurological alterations involving gait. This study was conducted in the Biomechanics Laboratory of Centro de Ciências da Saúde e do Esporte da Universidade do Estado de Santa Catarina (CEFID/UDESC), with approval of the Institutional Review Board of this university.

SURGICAL TECHNIQUE

The surgical technique consisted of the performance of a medial incision, four to six centimeters long, at the level of the first metatarsophalangeal joint. A Y-shaped capsulotomy was performed afterwards, with release of the soft parts and removal of the medial eminence of the first metatarsal. This was followed by the modified Chevron osteotomy with apex at the center of the metatarsal head and with the arms forming an angle of approximately 80°. The upper arm was positioned parallel to the ground line, and

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was longer than originally described, and the shorter, lower arm, almost perpendicular to the upper one. The proximal fragment of the osteotomy was displaced laterally permitting correction of varus of the first metatarsal. After the correction of the deformity, the osteotomy was fastened by two mini-fragment screws, followed by the regularization of the medial edge of the 1st metatarsal, capsulorrhaphy with 1-0 vicryl thread, approximation of the subcutaneous cell tissue with 2-0 vicryl thread and closing of the skin with 3-0 mononylon thread.

It is important to emphasize that in eight of the 27 feet evaluated Chevron osteotomy was performed in association with Weil osteotomy, a procedure carried out on the second toe for correction of metatarsalgia. After the surgical procedure the patients followed the same postoperative protocol, without the performance of any rehabilitation program. Partial weight bearing with Barouk sandal was allowed in 24 hours. This sandal was removed between 4 and 6 weeks, allowing full weight bearing.

Clinical and Radiographic Evaluation

All the evaluations were carried out at the Biomechanics Laboratory of CEFID/UDESC, before and three months after surgery. The clinical evaluation was performed according to the evaluation criteria for hallux, metatarsophalangeal and interphalangeal joints, proposed by the American Orthopedic Foot and Ankle Society (AOFAS).[9] Standardized weight-bearing anteroposterior X-rays were also performed in which the hallux valgus angle (HVA) and intermetatarsal angle (IMA) were obtained, in conformity with Coughlin et al.[10]

The HVA is the angle formed between the straight line segments that correspond to the mid-diaphyseal axis of the proximal phalange of the hallux and the mid-diaphyseal axis of the 1st metatarsal. The mid-diaphyseal axis of the proximal phalange is formed by two reference points, drawn from 0.5 to 1 centimeter from the distal and proximal articular surface of the phalange. The mid-diaphyseal axis of the 1st metatarsal is formed by two landmarks, with one drawn from 1 to 2 centimeters from the proximal articular surface and the other drawn at the center of the head. A ruler with concentric circles was used to locate the center of the head of the 1st metatarsal, and the geometric center of the circle was positioned halfway from the distal and lateral surface of the head.[10]

The IMA is the angle formed between the straight line segments, which corresponds to the mid-diaphyseal axis of the 2nd metatarsals and to the mid-diaphyseal axis of the 1st metatarsal. The mid-diaphyseal axis of the 2nd metatarsal is formed by two landmarks, drawn from 1 to 2 centimeters from the distal and proximal articular surface of this bone. The mid-diaphyseal axis of the 1st metatarsal was traced, as previously described.[10]

Baropodometric Evaluation

The subjects were submitted to the baropodometric evaluation through the EMED-at system (Novel, Germany). The platform has dimensions of 610x323x18mm, 1760 capacitive sensors, resolution of 2 sensors/cm^2 and acquisition frequency of 50 Hz. The minimum pressure registered by the equipment is 10KPa and the maximum pressure is 950KPa.

During the evaluation the individual walked barefoot in a straight line, at the speed of 4.5 Km/h (±5%), on an EVA (ethylene vinyl acetate) walkway, eight meters in length. This speed was chosen as according to other studies it is the average speed adopted by adult individuals.[11,12] The baropodometric platform was positioned at the center of this walkway to avoid a difference between the platform height and the ground. The individual was instructed to walk with eyes fixed on the horizon, without worrying about stepping in the active area of the measurement platform. Speed was controlled through 2 photocells and a chronometer, since as emphasized by literature speed interferes in the magnitude of kinetic variables.[13-15] Five valid steps taken by each foot on the platform were recorded to increase the trustworthiness of the plantar pressure measurements.[16-18] They were considered valid steps, when the individual stepped inside the platform with the entire sole of the foot, without the intention of getting this right and within the speed limit previously established.

The variables Peak Plantar Pressure (PPP), Pressure-Time Integral (PTI) and Relative Load (RL) were calculated using the mean value of the five valid steps. These variables were analyzed in 10 different plantar regions: calcaneous, midfoot, 1st, 2nd, 3rd, 4th and 5th metatarsals, hallux, 2nd toe and 3rd-5th toes, before and after the surgical correction procedure.

Statistical Analysis

The statistical analysis was performed through the SPSS (Statistical for Social Sciences Software) program, version 13.0. The Shapiro-Wilk test was used to verify data normality. The two-tailed t-test for paired samples was used for comparison of the variables between the pre- and postoperative periods. The confidence level adopted for all the comparisons was 95%.

RESULTS

Table 1 contains some characterization particulars of the subjects such as: age, side affected and surgical technique adopted, as well as the values obtained in the clinical and radiographic parameters in the pre- and postoperative evaluation.

According to the results presented in Table 2, it is verified that there was a statistically significant increase of the average score of the clinical evaluation of AOFAS in the postoperative period. In this evaluation 40 points are related to pain, 45 points represent function and 15 points represent toe alignment. In relation to pain the score increased from 17.1 to 33.7 points in the postoperative period. In the items related to function the score increased from 29.5 to 32.3 points, while in the criterion that represents alignment there was an increase from 4.2 to 14.5 points. A statistically significant improvement can also be observed in relation to the radiographic parameters, since there was correction of the deformity with mean reduction of 16.4° in the HVA and mean reduction of 6.7° in the IMA.

Table 3 shows the mean values and the standard deviation of the variable Peak Plantar Pressure (PPP) in the different regions of the sole of the foot, as well as the results of the comparison between pre- and postoperative periods. It is observed that in the group in which only the Chevron technique was performed, there was significant reduction of the PPP in the region of the 1st metatarsal, hallux and 2nd toe. There was also a significant increase of the PPP under the 3rd, 4th and 5th metatarsals. Now in the group that had the Chevron osteotomy performed in association with Weil osteotomy, it is observed that there was a statistically significant reduction of the PPP just in the region of the hallux, 2nd toe and 3rd-5th toes.

Table 4 presents the mean values and the standard deviation of the variable Pressure-Time Integral (PTI), in the different regions of the

Table 1 – *Characterization of the subjects.*

	Age	Side	AOFAS		HVA (degree)		IMA (degree)		Surgical Technique
			Pre	Post	Pre	Post	Pre	Post	
1	26	R	55	80	26	6	16	3	Chevron
2	26	L	55	80	21	5	14	3	Chevron
3	46	R	70	87	20	8	15	8	Chevron
4	62	R	58	90	24	6	12	11	Chevron
5	62	L	53	90	26	6	16	8	Chevron
6	54	R	58	87	30	10	16	4	Chevron + Weil
7	54	L	58	87	20	18	15	7	Chevron + Weil
8	38	R	63	90	23	10	11	5	Chevron
9	64	R	42	67	32	15	16	9	Chevron + Weil
10	64	L	22	62	41	25	15	13	Chevron + Weil
11	28	R	32	90	26	9	14	7	Chevron
12	28	L	60	90	15	4	11	6	Chevron
13	52	R	58	80	32	6	13	5	Chevron
14	52	L	58	90	35	7	14	7	Chevron
15	50	R	63	72	19	6	12	4	Chevron
16	60	L	55	90	26	2	16	12	Chevron
17	47	L	60	87	16	3	12	7	Chevron
18	26	R	55	62	20	14	11	8	Chevron
19	26	L	47	62	29	10	13	5	Chevron
20	62	R	27	83	44	15	17	12	Chevron + Weil
21	62	L	27	73	40	20	15	14	Chevron + Weil
22	61	R	73	77	17	11	18	8	Chevron
23	61	L	27	77	31	6	18	14	Chevron
24	53	R	55	85	30	22	16	8	Chevron
25	53	L	30	75	26	13	12	7	Chevron
26	56	R	57	85	30	15	16	6	Chevron + Weil
27	56	L	57	75	30	15	14	8	Chevron + Weil

Table 2 – *Comparison of the clinical and radiographic parameters between the pre- and postoperative periods.*

N = 27	Pre	Post	Sig.
	Mean ± SD (Min-Max)	Mean ± SD (Min-Max)	
AOFAS	50.9 ± 14 (22-73)	80.5 ± 9.4 (62-90)	0.000**
HVA (°)	27 ± 7.5 (15-44)	10.6 ± 5.9 (2-25)	0.000**
IMA (°)	14.4 ± 2 (11-16)	7.7 ± 3.2 (3-14)	0.000**

SD - standard deviation; Min - minimum; Max - maximum; Sig - Significance; Significant difference * - p ≤ = 0.05 ** - p ≤ = 0.01

Table 3 – *Comparison of the mean values of the variable Peak Plantar Pressure between the pre- and postoperative periods.*

Peak of Pressure (Kpa)						
	Chevron n = 19			Weil n = 8		
Region	Pre	Post	Sig.	Pre	Post	Sig.
Plantar	Mean ± SD	Mean ± SD		Mean ± SD	Mean ± SD	
Calcaneous	359.3 ± 83.5	336.7 ± 68.2	0.122	311.6 ± 24.9	304.4 ± 27.6	0.584
Midfoot	101.6 ± 25.4	102.5 ± 30.5	0.86	131.0 ± 24.7	125.8 ± 28.3	0.332
1st Meta	301.5 ± 158.8	161.2 ± 41.1	0.002**	388.8 ± 158	336.7 ± 138.7	0.539
2nd Meta	396.4 ± 191.9	470.3 ± 156.5	0.071	584.0 ± 266.8	519.0 ± 215.3	0.062
3rd Meta	354.3 ± 161.7	421.7 ± 125.6	0.015**	562.4 ± 299.6	444.1 ± 122.5	0.179
4th Meta	191.3 ± 51.6	269.4 ± 57.6	0.000**	272.4 ± 131.1	273.2 ± 70.5	0.986
5th Meta	127.8 ± 78.3	213.7 ± 144.1	0.003**	158.2 ± 77.9	160.6 ± 36.5	0.917
Hallux	482.4 ± 219.5	126.9 ± 76.1	0.000**	345.5 ± 100.6	161.3 ± 124.4	0.013**
2nd Toe	200.2 ± 94.6	171.2 ± 75.4	0.05*	208.4 ± 90.8	91.1 ± 103.4	0.041*
3rd-5th Toes	143.8 ± 58.8	129.5 ± 46.3	0.192	167.4 ± 118.8	85.5 ± 107.9	0.028*

SD - standard deviation; Significant difference * - p ≤ = 0.05 ** - p ≤ = 0.01

Table 4 – *Comparison of the mean values of the variable Pressure-Time Integral between pre- and postoperative periods.*

Pressure-Time Integral (Kpa*s)						
	Chevron - n = 19			Weil - n = 8		
Region	Pre	Post	Sig.	Pre	Post	Sig.
Plantar	Mean ± SD	Mean ± SD		Mean ± SD	Mean ± SD	
Calcaneous	70.6 ± 14.3	72.4 ± 15.8	0.421	65.2 ± 6.4	72.0 ± 9.2	0.011**
Midfoot	23.7 ± 6.8	29.0 ± 11.0	0.004**	34.9 ± 9.8	37.8 ± 7.4	0.108
1st Meta	64.8 ± 28.8	42.6 ± 11.6	0.005**	87.7 ± 44.5	93.3 ± 46.5	0.779
2nd Meta	91.2 ± 39.2	110.2 ± 35.1	0.026*	131.0 ± 69.5	153.2 ± 99.4	0.145
3rd Meta	84.8 ± 31.9	105.4 ± 28.9	0.001**	137.8 ± 90.9	130.1 ± 59.1	0.59
4th Meta	52.8 ± 14.9	76.2 ± 16.9	0.000**	74.1 ± 33.9	79.6 ± 19.3	0.569
5th Meta	34.2 ± 17.2	58.9 ± 32.0	0.000**	45.8 ± 19.4	50.3 ± 10.9	0.336
Hallux	84.4 ± 42.8	16.3 ± 12.8	0.000**	60.0 ± 10.8	20.9 ± 14.4	0.001**
2nd Toe	31.0 ± 13.5	29.8 ± 13.8	0.576	34.5 ± 19.9	7.9 ± 12.2	0.018*
3rd-5th Toes	24.6 ± 9.3	24.3 ± 9.9	0.842	33.6 ± 28.6	12.3 ± 19.8	0.035*

SD - standard deviation; Significant difference * - p ≤ = 0.05 ** - p ≤ = 0.01

sole of the foot, and the results of the comparison between pre- and postoperative periods. The variable of PTI reflects the quantity of pressure applied in the period of time in which the plantar region is in contact with the ground. Analyzing in the table the results of the group that performed Chevron osteotomy only, it is possible to verify a significant reduction of the PTI in the region of the 1st metatarsal and of the hallux, as well as a significant increase of the PTI in the region of the midfoot, 2nd, 3rd, 4th and 5th metatarsals, which indicates increase of overload in these plantar regions soon after surgery. On the other hand, analyzing the results of the group submitted to association with Weil osteotomy, we verified a significant reduction of the PTI in the region of the hallux, 2nd toe and 3rd-5th toes, with a significant increase of the PTI just in the calcaneous region.

Table 5 shows the mean values and the standard deviation of the variable Relative Load (RL), in the different regions of the sole

Table 5 – *Comparison of the mean values of the variable Relative Load between pre- and postoperative periods.*

Relative Load (%)						
	Chevron - n = 19			Weil - n = 8		
Region	Pre	Post		Pre	Post	
Plantar	Mean ± SD	Mean ± SD	Sig.	Mean ± SD	Mean ± SD	Sig.
Calcaneous	32.9 ± 4.9	31.7 ± 4.6	0.197	28.7 ± 3.5	28.9 ± 5.2	0.741
Midfoot	6.0 ± 3.2	7.5 ± 4.3	0.008**	11.1 ± 3.7	11.2 ± 3.6	0.901
1st Meta	11.4 ± 4.2	7.3 ± 2.3	0.001**	10.9 ± 3.2	12.7 ± 4.7	0.471
2nd Meta	12.9 ± 3.0	15.1 ± 3.4	0.022*	11.2 ± 1.9	14.0 ± 3.3	0.078
3rd Meta	14.2 ± 3.2	17.4 ± 2.7	0.001**	15.9 ± 3.0	16.1 ± 2.4	0.847
4th Meta	8.0 ± 1.9	10.7 ± 2.4	0.000**	9.9 ± 1.8	10.5 ± 1.7	0.568
5th Meta	3.3 ± 1.6	4.8 ± 2.3	0.001**	4.1 ± 1.5	4.0 ± 0.7	0.855
Hallux	7.3 ± 2.7	1.7 ± 1.3	0.000**	3.9 ± 0.9	1.3 ± 0.8	0.001**
2nd Toe	1.6 ± 0.7	1.4 ± 0.8	0.136	1.3 ± 0.7	0.2 ± 0.4	0.006**
3rd-5th Toes	2.1 ± 1.1	1.9 ± 1.1	0.34	2.3 ± 2.2	0.6 ± 1.3	0.024*

SD - standard deviation; Significant difference * - p ≤ = 0.05 ** - p ≤ = 0.01

of the foot, and the results of the comparison between pre and postoperative periods. The variable RL reflects the percentage of total force that is being exerted in each region of the sole of the foot. It is observed in the table that in the group submitted only to Chevron osteotomy there was a percentage reduction of force in the region of the 1st metatarsal and hallux, as well as a statistically significant increase of RL in the midfoot, 2nd, 3rd, 4th and 5th metatarsals. However, in the group that underwent associated Weil osteotomy the significant alterations were restricted to the region of the toes, with percentage reduction of force in the region of the hallux, 2nd toe and 3rd-5th toes.

Figure 1 illustrates the behavior of the distribution of plantar pressures before and after surgical correction of hallux valgus deformity, by the Chevron technique. Through the figure it is possible to qualitatively observe that soon after surgery there was a reduction of pressure in the medial region of the forefoot, in the hallux and in the toes, with increase of pressure under the central and lateral metatarsals.

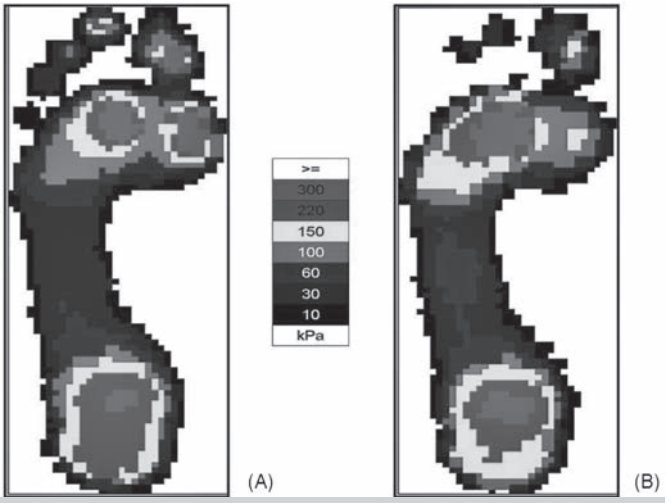

Figure 1 – *Dermatoglyphics of the left foot of a patient with valgus hallux before (A) and after (B) surgical correction by Chevron osteotomy.*

Figure 2 illustrates the behavior of plantar pressure distribution before and after surgical correction of the hallux valgus deformity, by the Chevron technique associated with Weil osteotomy. It is possible to identify that soon after surgery there was also a reduction of pressure in the medial region of the forefoot, in the hallux and in the toes, as well as an increase of pressure under the central and lateral metatarsals. In other words, through a qualitative analysis no major differences are observed between Figures 1 and 2, although the quantitative analysis has showed different results.

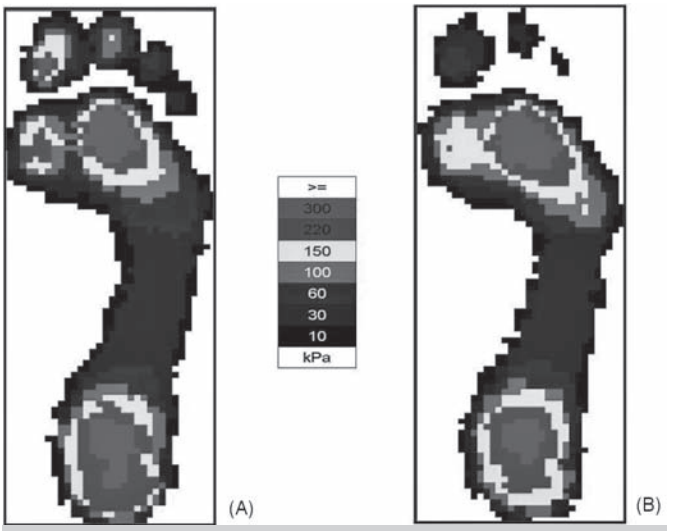

Figure 2 – *Dermatoglyphics of the right foot of a patient with valgus hallux before (A) and after (B) surgical correction by Chevron osteotomy in association with Weil osteotomy.*

DISCUSSION

In relation to the results of the AOFAS evaluation, satisfactory clinical evolution was observed, particularly in relation to pain and to alignment, with significant increase of the average score of AOFAS climbing from 50.9 to 80.5, although the revaluation was performed not long after the beginning of the postoperative period. Other authors also used the clinical criteria of AOFAS, after different follow-up times, to evaluate the clinical profile of patients that underwent surgical correction of hallux valgus deformity, by Chevron osteotomy.[4,6,19] The results of Ruaro et al.[4] demonstrated an increase of the AOFAS score from 50 to 91.7 points, 6 months after surgery. Nery et al.[6] also evidenced an increase of the AOFAS score going from 50 points in the preoperative period to 90.5 points in a 2-year follow-up. In a prolonged follow-up period, Trnka et al.[19] observed significant clinical improvement with an increase of the score from 59 to 91 points, when comparing the preoperative and 2-year postoperative periods. However, the same author did not find differences in the AOFAS score, when comparing the 2nd and 5th postoperative year periods.

Comparing our results, it is believed that the highest score obtained in the other studies is related to the longer postoperative time, allowing better recovery of the patient, particularly in the aspects related to function. According to the results of this study, it is verified that modified Chevron osteotomy is a surgical procedure capable of bringing about an improvement in the clinical profile of the patient on the short term, although 3 months is a short period to evidence all the clinical benefits afforded by surgical correction. However, similar clinical results were report at 6 months, 2 years and 5 years postoperative, which leads us to believe that 6 months after surgery, the clinical aspects tend to stabilize.[4,6,19]

Most studies use only the radiographic clinical parameters to assess the efficacy of different surgical techniques in the correction of hallux valgus deformity. However, authors demonstrated the existence of significant differences in the angular measurements obtained with radiographic exams, when different measurement techniques are used, particularly in the postoperative period.[10,20-22]

In this study, we opted for the method that uses the center of the head of the first metatarsal as a landmark to trace the axis and to measure HVA, as according to some authors this technique presents less variability, after distal osteotomies.[10,22]

Ruaro et al.[4], as is the case in our study, evaluated the radiographic parameters three months after surgical correction of hallux valgus deformity by the Chevron technique. Their results demonstrated reduction of 19.2° in the HVA and of 8.3° in the IMA. Resch and Stenstrom[23] conducted a radiographic study on 22 feet operated by the Chevron technique. The evaluations were performed on average after 25 preoperative months and the results demonstrated mean correction of 14° in the HVA and of 4° in the IMA. Nery et al.[6], in verifying the efficacy of a Chevron osteotomy, in the correction of slight and moderate hallux valgus deformity, reached a mean correction of 11° in the HVA and 4° in the IMA. Sanhudo,[7] after the surgical technique in modified Chevron for correction of moderate to severe hallux valgus, reached a mean correction of 22.2° in the HVA and of 10.7° in the IMA. Comparing the results of the studies it is perceived that there are variations in the quantity of correction of the HVA and IMA after Chevron osteotomy. This fact can be related to the different degrees of deformity presented by the participants of each study and to minor modifications in the surgical technique. Moreover, as reported previously, the radiographic parameter measuring method alters the value of the angular measurements, hampering the comparison of results. Nevertheless, it is possible to affirm that Chevron osteotomy is capable of correcting hallux valgus deformity, producing a significant reduction of the HVA and IMA.

This study also evaluated the baropodometric alterations provoked by the surgical correction of the deformity on a short term. The plantar pressure distribution pattern presented by the individuals, after isolated Chevron osteotomy, demonstrated a reduction of all the variables in the region of the 1st metatarsal and of the hallux, as well as an increase of the variables in the region of the central and lateral metatarsals. Thus it is possible to say that on the short term, there was a transfer of loads from the medial region to the lateral region of the forefoot. This result can be easily explained by the short postoperative period and by the record of varus and supination during gait presented by the majority of patients, certainly due to pain or fear of letting their weight rest on the operated medial region. Kernozek et al.[24] who performed the evaluation before and eight weeks after Chevron-Akin osteotomy for correction of hallux valgus, encountered results similar to that of this study, with decrease of PPP and Force-Time Integral (FTI) in the hallux region, as well as an increase of the latter variable in the region of the central (2nd and 3rd) and lateral (4th and 5th) metatarsals.

In a longer follow-up period, with the revaluation being performed 12 months after surgery, Kernozeck et al.[25] continued to record lower PPP, PTI and FTI under the hallux after Chevron osteotomy, as well as a higher peak of pressure and peak of force in the central region of the forefoot (2nd and 3rd metatarsals) after surgery. Nyska et al.[26] recorded, 18 months after the performance of a proximal osteotomy of the first metatarsal, an increase of PTI in the central region (2nd and 3rd metatarsals) and lateral region (4th and 5th metatarsals) of the forefoot, as well as an increase of the variable FTI in the midfoot and in the central region of the forefoot. However, no alterations were evidenced for the hallux region. Resch and Stenstrom,[23] who performed the plantar pressure distribution evaluation on average 25 months after surgical correction of the deformity by the Chevron technique, also found lower PPP under the hallux and 1st metatarsal with increase of pressure under the 3rd metatarsal. Saro et. al.,[27] who verified the plantar pressure distribution pattern 12 months after two different distal osteotomy techniques, did not identify an increase of PPP in the hallux after surgery. Nery[28] performed a baropodometric evaluation on 26 patients treated by Chevron osteotomy. This evaluation was performed on average 3 years after surgery and the results were compared with a control group, without the presence of deformity, and with a group of individuals with hallux valgus deformity. The analysis demonstrated that in the group of individuals with unsatisfactory postoperative clinical results the mean pressure under the 2nd metatarsal was identical to that of the group with the presence of deformity, and thus higher than the mean pressure presented by the control group in the same region. In other words, in the individuals with postoperative status considered unsatisfactory, the persistence of overload was observed on the 2nd metatarsal. Moreover, the results also demonstrated significantly lower values of pressure under the hallux in the operated group when compared with the other groups, that is, there was no normalization of the dynamic function of the hallux after the surgical technique.

Analyzing the results presented in different studies, it is observed that on the short and long term, surgical correction of hallux valgus deformity provokes alterations in the baropodometric variables, mainly in the hallux region. There is not yet any evidence of effective changes on the long term, because in the studies analyzed some of the plantar pressure distribution variables remain altered in the region of the hallux after surgery. However, more long-term studies are necessary, with the use of control groups to provide trustworthy evaluations in relation to the baropodometric alterations after correction surgeries. There are two theories related to continued presence of hallux deficiency. The first emphasizes that the surgical procedure weakens the intrinsic muscles, around the first metatarsophalangeal joint, and promotes articular stiffness altering the mechanical function of the hallux.[25,29] It is known that the metatarsophalangeal joints are extremely important during gait, as they act as levers in the propulsion phase (toe off), affording stabilization of the longitudinal arch. However, good range of motion of these articulations is necessary to develop the adequate level of tension in plantar aponeurosis and to favor propulsion during gait.[30]

Therefore, after the surgical correction of the deformity, is possible to relate the lack of gain of range of motion in the metatarsophalangeal joint to the difficulty of recovery of force in the hallux. The second theory is based on the fact that the patients simply repeat the gait pattern that they used prior to surgery.[25,29]

In the case of this study, in which the baropodometric evaluation was performed just three months after surgery, the changes observed after Chevron osteotomy, both isolated and in association with the Weil osteotomy, are probably related to pain and the inability to bear the load in the operated region. After isolated Chevron osteotomy there was a reduction of all the variables in the region of the hallux and 1st metatarsal, requiring compensation by the midfoot and the central and lateral metatarsals to the effect of producing more force for the gait population phase. While in the Chevron osteotomy associated with Weil osteotomy the significant changes occurred in the region of the hallux and of the toes, with reduction of all the variables in these regions. Therefore, emphasis is placed on the importance of continuing with this study to verify possible changes in the load pattern, after a more prolonged postoperative period.

After all the changes observed in the baropodometric evaluation performed soon after surgery, and based on the results reported by other authors in evaluations performed on the long term, it is believed that to obtain satisfactory results, in relation to the normalization of plantar loads, it is necessary to invest in rehabilitation programs after the surgical hallux vagus correction procedure. This therapeutic intervention should include gain of range of motion, muscular reinforcement and gait training. In fact the actual baropodometric evaluation should be used in the postoperative period, as a resource to drive gait training, in pursuit of better functionality of the hallux to attain a closer-to-normal pressure distribution pattern.

CONCLUSION

It is concluded that modified Chevron osteotomy is a surgical procedure capable of influencing, on the short term, the clinical and baropodometric characteristics of the gait of individuals with hallux valgus. After surgical correction of the deformity a significant improvement was verified in the clinical profile of the patients with correction of the radiographic parameters. In relation to the baropodometric evaluation a reduction of pressure and of load was observed in the region of the 1st metatarsal and of the hallux, with an increase of these variables in the region of the central and lateral metatarsals, that is, a transfer of loads from the medial to the lateral region of the forefoot, possibly due to the short postoperative period. Therefore, it is necessary to continue this study to verify possible alterations in the load pattern, after a more prolonged period.

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