VERTICAL GROUND REACTION FORCE DIFFERENCES IN RUNNERS WITH LEG LENGTH DISCREPANCY

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INTRODUCTION

Leg Length Discrepancy (LLD) is so common that is considered normal by many authors and frequently it has occurred concomitant to low back pain (LBP), stress fractures (SF) and osteoarthritis (OA). The investigators have not found yet how many difference of LLD is necessary to provide these problems [3]. Large differences are generally diagnosed in youth, but smaller amounts of LLD may be unrecognized until some symptom come up. An anatomic disparity could be partial or totally compensate by functional adaptations. Biomechanical gait analysis could help discriminating between functional and structural LLD [2]. Therefore, we compared vertical ground reaction force (GRF) during running in two LLD groups of runners and one control group without inequality in order to identify if this structural inequality may cause changes and dynamic adaptations of gait.

METHODS

175 physically active subjects were submitted to a personal interview and anthropometric measurements of the lower limbs to investigate run training, symptoms and to identify possible leg differences. Subjects with LLD detected by clinical measurements done in the first stage of the study were oriented to perform a Scanogram to certify the difference. From these subjects, we formed our experimental groups: Discrepancy and Symptom Group (DSG)-40 LLD runners higher than 0.3cm with LBP and/or SF, mean age 31±5 yrs; Discrepancy Group (DG)-15 LLD runners higher than 0.3cm without symptoms, mean age 27±4 yrs; and Control Group (CG)-15 physically active subjects with zero to 0.3cm leg discrepancy, mean age 32±5 yrs. Vertical GRF were analyzed during running at a self-selected speed using a Force Plate AMTI [2]. The subjects wore their habitual running shoes during analysis. Five trials of each lower limb of each subject were acquired at a sampling rate of 200 Hz. The vertical GRF variables analyzed were: first peak of force (Fy_1); second peak of force (Fy_2); time to reach Fy_2 (Δt_2) and rate of loading ($RL=Fy_1/\Delta t_1$). The groups were compared using ANOVA post hoc Scheffé and between legs for each group dependent t-test. We adopted $p<0.05$ for significant differences.

RESULTS AND DISCUSSION

GRF data and p values are showed in the table 1. According to literature [1], DG presented greater Fy_2 at the longer limb, and greater values in comparison to CG and DSG. These findings could be related to the smaller values of Δt2, it could represent high mechanical loads at toe-off phase in subjects with LLD. The cumulative effect of overload during long periods on the longer limb could generate symptoms, as OA of the hip. The inclination of the pelvis to the shorter side could create a decreased area of loading at the acetabulum and the association of higher loads at the longer limb could lead to the OA [1]. Contradicting literature, that assume higher values of Fy_1 at longer limb, DSG and DG presented higher Fy_1 at shorter limb [2, 3, 4]. In agreement to some authors [1, 2, 3], this could represent a light compensatory mechanism adopted in mild discrepancies capable to minimize overloads. DSG showed significant lower values of Fy_1 related to CG. This fact might be related to symptoms observed in DSG subjects and could be explained as a dynamic strategy adopted in both sides to minimize mechanical overloads. DSG subjects also showed smaller values of RL in comparison to the other groups and this finding could be possibly explained as an anticipatory reaction in order to reduce overload at heel strike [1, 4]. DSG presented higher values of Δt_2 at shorter limb in comparison to CG, and at longer limb in comparison to CG and DG, representing greater time to reach a small Fy_2.

CONCLUSIONS

DSG presented smaller vertical force peaks and greater time to reach them in comparison to the other experimental groups. These results could be related to a dynamic strategy adopted in both sides of subjects with LLD in order to reduce overloads that might be leading to the symptoms observed in LLD subjects. DG showed higher Fy_2 at longer side and it could generate symptoms as LBP, stress fractures and precocious joint degeneration.

REFERENCES

1. Bhave et al. Improvement in gait parameters after lengthening for the treatment of limb length discrepancy. *J. Bone Joint Surg*., .**81A (4),** 529-34, 1999.
2. Kaufman, K.R. et al. Gait asymmetry in patients with limb length inequality. *J. Pediatr Orthop* **, 16**, 144-50, 1996.
3. McCaw, S.T. et al. Biomechanical implications of mild leg length inequality**. *Br. J. Sport. Med*.**, **25 (1)**, 10-13, 1991
4. Perttunen, J.R. et al. Gait asymmetry in patients with limb length discrepancy. Scan *J. Med. Sci.Sports*, **14,** 49–56, 2004.

ACKNOWLEDGEMENTS

We thank FAPESP for financial support (03/08165-7).

Table 1: GRF data and p-values of the experimental groups.

	CG		DSG		DG		p-value	
	greater	**shorter**	**greater**	**shorter**	**greater**	**shorter**	**greater**	**shorter**
Fy_1	1.48±0.31 ^{a}	1.50±0.29	1.28±0.27 ^{a}	1.37±0.28	1.40± 0.24	1.50±0.20	0.1724	0.1036
Fy_2	2.10±0.26 ^{a}	2.09±0.35 ^{c}	2.13 ±0.24 ^{b}	2.13±0.18 ^{d}	2.42± 0.15 $^{a, b}$	2.35± 0.18 $^{c, d}$	0.0482	0.1837
Δt_2	0.12± 0.01 ^{a}	0.12±0.00 ^{c}	0.13 ±0.02 $^{a, b}$	0.13±0.01 ^{c}	0.11± 0.01^b	0.12± 0.01	0.0002	0.0242
Fy1/Δt1 y	32.93±7.63 ^{a}	29.89±9.42 ^{c}	25.19 ±6.63 $^{a, b}$	26.55±6.09 $^{c, d}$	35.55± 17.63^b	31.82±9.55 ^{d}	0.0710	0.1172