THE IMMEDIATE EFFECTS OF THREE RUNNING TECHNIQUES ON LOWER LIMB AND TRUNK KINEMATICS

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INTRODUCTION

RUNNERS OVER THE WORLD

- EXPONENCIAL GROWTH
- OVER 30 MILLION OF NORTH AMERICANS PRACTICE RUNNING[1]

RISK OF INJURY

- COMBINATION OF EXTRINSIC AND INTRINSIC FACTORS[2]
- 56% OF RECREATIONAL RUNNERS AND MORE THAN 90% OF RUNNERS PRESENT SOME INJURY EVERY YEAR[3]

IMPROVE INJURY PREVENTION AND REHABILITATION PROGRAMS

- INVESTIGATION OF THE EFFECT OF DIFFERENT RUNNING TECHNIQUES ON LOWER LIMB BIOMECHANICS

- 3 RUNNING TECHNIQUE MODIFICATIONS HAS THE POTENTIAL TO REDUCE THE DEMAND ON THE KNEE JOINT:
  1. LANDING WITH THE FOREFOOT (FFOOT)[4,5]
  2. INCREASING 10% OF THE STEP RATE (10%SR)[6]
  3. INCREASING THE TRUNK FLEXION (TFLEX)[7]

- **RESEARCH OBJECTIVE: INVESTIGATE THE IMMEDIATE EFFECTS OF 3 RUNNING TECHNIQUES MODIFICATIONS ON ANKLE, KNEE, HIP AND TRUNK KINEMATICS.**

METHODS

- **SUBJECTS:** 31 REARFOOT-STRIKE HEALTHY RUNNERS (11 F, 20 M) **(TABLE 1)**;
- **INCLUSION CRITERIA:** RUN A MIN OF 20 KM/WEEK FOR AT LEAST 3 MONTHS[4,6];
- THE PREFERRED SPEED (2.67 ± 0.39 M/S) AND STEP RATE (167.35 ± 7.08 STEPS PER MINUTE) WERE DETERMINED ON FAMILIARIZATION SESSION (3 DAYS BEFORE);

TABLE 1: BASELINE DEMOGRAPHIC CHARACTERISTICS.

AGE (YEARS)	BODY MASS INDEX (KG/M²)	RUNNING EXPERIENCE (YEARS)	RUNNING DISTANCE (KM/WEEK)	DOMINANT LIMB
27.67 (5.43)	23.74 (2.92)	4.13 (4.02)	35.70 (18.25)	26 R; 5 L

- **KINEMATICS ASSESSMENT:**
  - 6 CAMERA SYSTEM (QUALYSIS) ON A TREADMILL (240 HZ);
  - 20 PASSIVE REFLECTIVE ANATOMICAL MARKERS AND 3 TRACKING MARKERS WERE POSITIONED (**FIGURE 1**);
  - THE ORDER OF TECHNIQUES WAS RANDOMIZED FOR EACH SUBJECT;
- THE DATA WAS RECORDED DURING 10 S FOR EACH TECHNIQUE (**FIGURE 2**), ALL VARIABLES WERE AVERAGED ACROSS **10-FOOT CONTACTS** FROM THE DOMINANT LOWER LIMB, DETERMINED BY THE MINIMUM VERTICAL POSITION OF THE DISTAL HEEL MARKER FOR USUAL RUNNING (USRUN), 10% SR AND TFLEX, AND USING THE HALLUX MARKER FOR FFOOT;
- THE VISUAL 3D SOFTWARE (C-MOTION) AND MATLAB (MATHWORKS) WAS USED TO QUANTIFY THE MOVEMENTS OF THE FOOT, KNEE, HIP AND TRUNK.

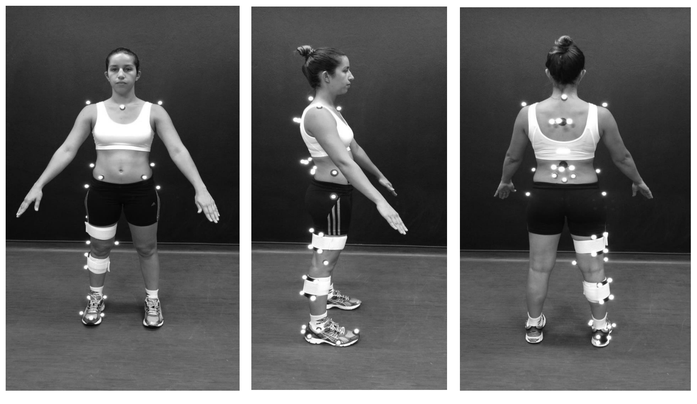

Figure 1: Maker placement on the lower extremity.

Figure 2: Running data collection.

- **CONFIRMATION OF TECHNIQUES:**
  - **FFOOT:** ANALYZING THE REAL TIME PLANTAR PRESSURE DISTRIBUTION WITH INSOLE SENSORS (PEDAR-X SYSTEM, NOVEL GMBH);
  - **10% SR:** MONITORED USING A METRONOME;
  - **TFLEX:** VISUALLY CONFIRMED.

RESULTS AND DISCUSSION

- RUNNING TECHNIQUE MODIFICATIONS COULD ALTER LOWER LIMB KINEMATICS:

TABLE 2: MEAN (SD) JOINT ANGLE MEASURES DURING EACH RUNNING CONDITION.

	Running Condition			
	USRUN	FFOOT	10%SR	TFLEX
Ankle				
Plantar flexion (+)	8.27 (6.43)	16.82 (4.93)**	9.63 (6.06)	6.40 (6.11)*
Knee				
Flexion (+)	25.73 (9.03)	34.39 (6.38)**	28.10 (7.29)*	25.85 (9.26)
Abduction (+)	-2.95 (5.25)	-4.15 (4.62)*	-2.80 (4.81)	-3.68 (5.06)*
External rotation (-)	-13.86 (6.13)	-8.45 (5.09)**	-11.73 (5.72)*	-14.12 (6.33)
Hip				
Flexion (+)	30.82 (8.63)	18.14 (10.13)**	27.43 (9.00)*	34.98 (10.00)**
Adduction (-)	-8.80 (3.56)	-6.84 (3.31)*	-8.52 (3.22)	-8.41 (2.84)
Internal rotation (+)	12.80 (3.85)	8.39 (4.91)**	11.44 (3.82)*	12.61 (3.98)
Trunk				
Flexion (+)	7.96 (5.41)	8.10 (5.24)	8.12 (5.10)	14.14 (5.57)**

* $P < 0.05$ ** $P < 0.001$

- **FFOOT:** MINIMIZED THE KNEE AND HIP MOVEMENTS IN THE **FRONTAL AND TRANSVERSE PLANES;**
  - EXCESSIVE KNEE AND HIP MOVEMENTS IN THE FRONTAL AND TRANSVERSE PLANES ARE ASSOCIATED WITH GREATER STRESS ON THE PATELLOFEMORAL JOINT[8]
- **10%SR:** MORE SENSITIVE TO CHANGES IN THE **TRANSVERSE PLANE;**
  - CORROBORATED WITH PREVIOUS STUDY[6]
- **TFLEX:** MODIFY THE ANGLES IN THE **SAGITTAL PLANE**;
  - 6.18° TRUNK FLEXION INCREASE
  - PREVIOUS STUDY[7] IDENTIFY THAT 6.9° TRUNK FLEXION INCREASE CAUSES A **9% REDUCTION IN THE PATELLOFEMORAL JOINT STRESS** WITHOUT CHANGING THE KNEE FLEXION ANGLE.

CONCLUSION

- THIS WAS THE FIRST STUDY TO COMPARE USRUN WITH THESE 3 RUNNING TECHNIQUES;
- THE IMPLEMENTATION OF THE RUNNING TECHNIQUE SHOULD BE DONE GRADUALLY AND SUPERVISED BY A PROFESSIONAL.
- THE TECHNIQUES SHOWED **CLINICALLY RELEVANT RESULTS**;
- FUTURE STUDIES ARE NECESSARY TO CONFIRM THESE RESULTS AT LANDING AND FOR A LONG PERIOD IN ORDER TO ASSIST IN DEVELOPING PREVENTIVE AND REHABILITATION PROGRAMS.

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