Influence of loads to of the joint moments and muscle force repartition in sprint cycling test

Inès Benkhémis, Mathieu Boucher
[1]Laboratoire de mécanique des solides UMR-CNRS6610, Université de Poitiers, 86962 Futuroscope-Chasseneuil Cedex, France.
email: ines@etu.univ-poitiers.fr web : www-lms.univ-poitiers.fr

INTRODUCTION

The pedalling technique requires a complex muscular activation which depends on a few factors like the frequency, the loads [1]. The aim of this preliminary study is to compare the muscular force obtained when using the physiological cross-section area (PCSA) during a sprint test performed by a road and a track cyclists.

METHODS

The cycling tests were realized in laboratory conditions seated on a bicycle (Monark 824) equipped with clipless pedals fixed to a 6-axis sensor (Médicapteur Ex114-45-200). The two subjects (road cyclist: 70kg, 1.75m and track cyclist: 55kg, 1.65m) performed sprints on the ergo-trainer against a 2 and 8kg load. The motion was recorded at 50 Hz by an optoelectronic system (Saga3[rt]). We analyze the first pedalling cycle for each test. The lower limb is considered as a planar 3 degree of freedom. The moment arm and the PCSA values used are taken from [2]. The joint moment at ankle, knee and hip are obtained by the resolution of the inverse Dynamic equations and the muscular force by the minimization method.

RESULTS AND DISCUSSION

The first result indicates that the track cyclist (TC) develops more joint force than the road cyclist (RC). In fact, the figure 1 shows how the joint moments of TC are more important than RC. So, it is logical to obtain the greater muscular force values from the TC. However, the minimum value of the sum of joint moment and the sum of muscular forces are inferior (table 1). In this case we can conclude that the pedalling strategy is different.

The most important muscular force participation is the Long Head Biceps Femoris (BFL: a knee flexor and hip extensor) and the least are the Tibialis Anterior (TA: an ankle flexor) and the Short Head of Femoris (BFS: a knee extensor). At 8kg, the muscular force increases about 19% for TA and BFS and about 10% for BFL of the two cyclists.

Six of the nine low limb muscles fit into the knee.But the knee moments are the least at any load for the two subjects.

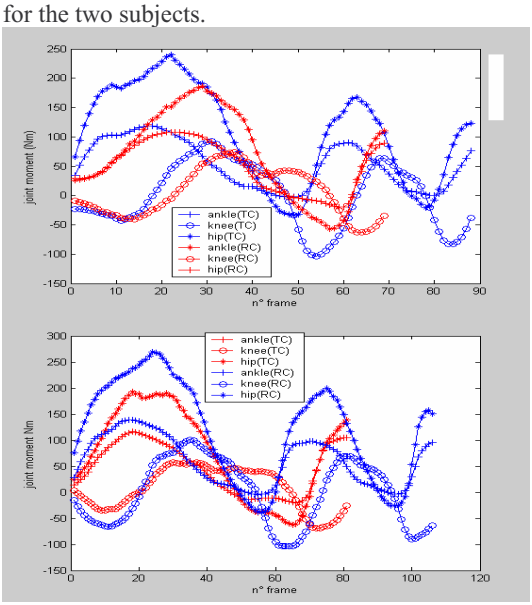

Figure 1: joint moments for the two cyclists at 2kg (top) and 8kg (bottom)

CONCLUSION

Our preliminary study shows the importance of the use of the individual muscle force to compare pedalling motion. It is useful to determinate the energy cost per muscle to define a cycling profile.

The inferiority in the knee moment needs more investigation and probably to relate it to the height of the seat.

REFERENCES

1. Baum B.S., Li Li, *J. electromyo. Kinesio*. **13**, 181-190, 2003.
2. Raikova R.T., Prilutsky B.I. *J Biomech* **34**, 1243-1255, 2001.

Table 1 : Minimum, maximum and mean values of the sum of joint moments and muscular force.

	2 kg				8 kg			
	TC		RC		TC		RC	
	moment	force	moment	force	moment	force	moment	force
min	20.6Nm	1200N	46.02Nm	1715N	34.65Nm	1196N	42.55Nm	1810N
max	406.6Nm	19800N	336.9Nm	15710N	460.8Nm	21790N	360.4Nm	17480N
mean	216.7Nm	9739N	175Nm	7560N	245.9Nm	10990N	186.5Nm	8401N