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Feasibility of moderate load eccentric bed cycling during dialysis

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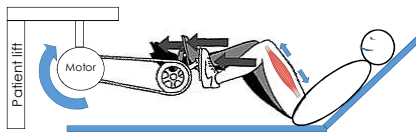
INTRODUCTION Renal disease constitutes a slow and progressive loss of kidney function. End-stage renal disease (ESRD) patients must substitute deficient kidneys and undergo dialysis, a treatment taking place three times a week for 4h. Hemodialysis patients are considered as super-sedentary, suffering from a chronic illness often associated with numerous comorbidities and displaying among the lowest daily activities. As physical activity decreases, deconditioning operates and conduces to an important muscle wasting, critical for patients' outcomes. Physical activity constitute an efficient form of intervention to restore functional abilities and quality of life of hemodialysis patients. Among exercises, moderate load bed-cycling seems to be the most propered. Nevertheless, old patients and those suffering from malnutrition are not able to sustain energy expenditure of conventional cycling, *i.e.* concentric cycling. Indeed, concentric contractions are associated with high metabolic and cardiovascular strains leading an early fatigue, which often motivates an abandonment. Recently, it has been proposed that negative work, *i.e.* eccentric cycling, could be an efficient strategy to exercise frail elderly people. Eccentric contractions produce high forces at low metabolic and cardiovascular costs and may largely improve muscular force and mass.

MATERIAL & METHODS This study aimed to evaluate feasibility and efficiency of moderate load eccentric bed-cycling training on 10 healthy individuals, and establish whether this training modality could be implemented into hemodialysis patients' routine care. Development of a bed-adapted eccentric ergometer allowed to conduct 5 training sessions during a 3 weeks period at increasing intensity. Force-speed relationship, maximal voluntary knee extension force and neural activation of all subjects were evaluated before and after the program.

1 DEVELOPMENT OF A BED-ADAPTED ECCENTRIC ERGOMETER

- Motor fixed to a patient lift
- Classic chainset in direct drive
- Pedals with integrated power meter

Subjects have to brake pedals' movement generated by the engine, producing eccentric contractions



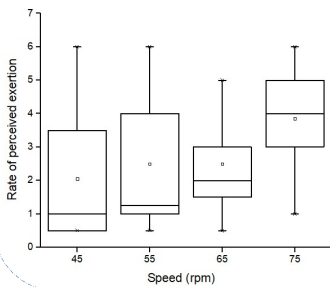
2 STUDY PARTICIPANTS & DESIGN

- 10 healthy volunteers : 4 women, 6 men
- Age : 39,5 ± 15,5 years old, Height : 175 ± 10 cm, Weight : 70 ± 16 kg
- Longitudinal study with autocorrelation of each participant

PRE → 5 training sessions → POST

Force-speed relationship (Friction loaded cycle)
Maximal voluntary contraction force (Dynamometer)
Neural activation during maximal contraction (EMG)

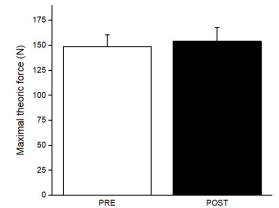
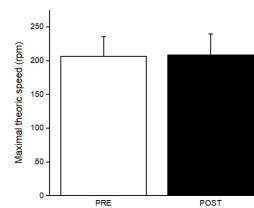
3 MODERATE LOAD ECCENTRIC BED-CYCLING TRAINING FEASIBILITY



- Rate of perceived exertion (RPE) was estimated on a modified Borg's scale :
0 = no effort to 10 = extremely hard
- RPE is not proportional to increased speed
- Speed <70 rpm was easier for all subjects

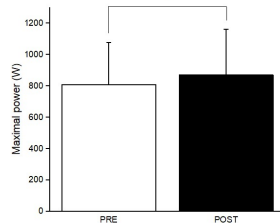
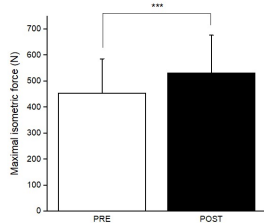
4 NO IMPROVEMENT OF MAXIMAL THEORIC FORCE AND SPEED

Force-speed relationship was not statistically different ($p=0,1$) after the program



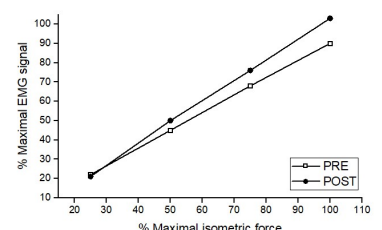
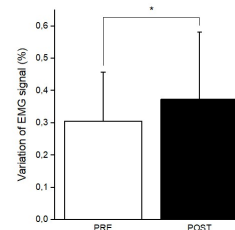
5 EARLY GAINS IN MAXIMAL ISOMETRIC FORCE AND CYCLING POWER

Maximal isometric force increased by 17% while maximal power increased by 8%



6 FUNCTIONAL AND STRUCTURAL MUSCLE ADAPTATIONS

EMG signal improvement (+22%) was mainly due to functional adaptations



CONCLUSION & PERSPECTIVES After 3 weeks of training, maximal voluntary knee extension force was significantly improved in all subjects, with a mean increase of 17% ($p<0.001$). Analysis of EMG signal showed a mean improvement of 22% ($p<0.05$) in neural activation of leg extensors muscles. Whether maximal cycling force and speed showed no significant changes ($p=0,1$), maximal cycling power was significantly higher (+8%) after training program. Taken together, these results show that 5 sessions of moderate load eccentric bed cycling (i) was feasible and efficient (ii) involved both structural and functional adaptations and (iii) allowed early force and power gains in healthy subjects. Implementation into dialysis' patients routine care could permit to promote exercise practice during dialysis without excessive perceived exertion, avoiding early fatigue and potential abandonments to training programs.