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Isokinetic trunk muscle performance in pre-teens and teens with and without back pain

Évaluation isocinétique de la force et de l'endurance en flexion et extension du tronc chez des adolescents témoins et lombalgiques

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Abstract

Objective. – To assess with an isokinetic dynamometer the force and endurance of the spinal flexor and extensor muscles in pre-teens or teens aged 11 to 13 and 14 to 16 years with and without low back pain (LBP).

Method. – The control group and the LBP group were homogeneous in terms of age, weight, height and Body Mass Index (BMI). Assessment was carried out with the isokinetic dynamometer Cybex Norm[®]. The spinal flexors and extensors were explored concentrically at speeds of 60°, 90° and 120°/sec. The parameters chosen were: maximal moment of force (MMF), mean power (MP), total work (TW), F/E ratios (between the flexors and the extensors for the aforesaid parameters). In the LBP groups, clinical information (pain, extensibility of the spinal and sub-pelvic muscles, sports practice) and sagittal radiological data were all measured.

Results. – While no significant difference in isokinetic performance was found between asymptomatic and LBP children in the 11-to-13-year-old group, the isokinetic performances of the LBP children were influenced positively by BMI value, number of hours of physical activity and radiologic value of the lumbar lordosis. As regards these pre-teens, assessment with an isokinetic dynamometer does not highlight muscle characteristics that might explain LBP occurrence. As regards the 14-to-16-year-old group, muscle strength has been found to be correlated with age. LBP teens were showed to have weaker extensors and stronger flexors than the healthy teens. It is with regard to this age group that assessment with an isokinetic dynamometer clearly yields interesting results. Since we have yet to standardize our evaluation criteria (working speed, number of trials...), it is difficult to compare our results with those reported in the literature.

Conclusion. – This is a preliminary study involving a relatively low number of patients. That said, given the fact that numerous parameters are connected with the age and height of the subjects, assessment with an isokinetic dynamometer can be constructively carried out from the age of 14. In order to further enhance understanding of this phenomenon, a longitudinal and comparative study of a larger group is needed.

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Keywords: Isokinetic; Children; (Pre-)teens; Strength; Trunk

Résumé

Objectif. – Évaluer au dynamomètre isocinétique la force et l'endurance des fléchisseurs et extenseurs du rachis de 2 groupes d'adolescents de 11 à 13 ans et de 14 à 16 ans.

Méthode. – Les groupes témoins et lombalgiques sont homogènes en âge, poids, taille, indice de masse corporelle. L'évaluation est effectuée au dynamomètre isocinétique Cybex Norm[®]. L'exploration se fait en concentrique, aux vitesses de 60, 90, et 120°/s. Les paramètres retenus sont : moment de force maximal, puissance moyenne, travail total série, ratios F/E (rapport fléchisseurs/extenseurs pour les paramètres

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précités). Concernant le groupe « lombalgique », des données cliniques (douleur, extensibilité des muscles sous-pelviens et rachidiens, pratique sportive) et radiographiques sagittales sont mesurées.

Résultats. – Pas de différence significative des performances isocinétiques entre les adolescents lombalgiques et les adolescents asymptomatiques dans la tranche d'âge retenue des 11–13 ans mais des performances isocinétiques chez les adolescents lombalgiques qui sont influencées positivement par la valeur de l'IMC, le nombre d'heures d'activité sportive et la valeur radiologique de la lordose lombaire. À la lumière de ce travail, et pour la tranche d'âge des 11–13 ans, il ne semble pas que l'évaluation par dynamomètre isocinétique apporte des éléments caractéristiques sur le plan musculaire pouvant expliquer la survenue de lombalgies. Pour la tranche d'âge 14–16 ans, on retient que la force musculaire est corrélée à l'âge et que les lombalgiques ont des extenseurs plus faibles que les témoins et inversement pour les fléchisseurs. Le dynamomètre isocinétique devient un mode d'évaluation intéressant. La comparaison des résultats à partir de la littérature est difficile tant que nous n'avons pas standardisé les critères d'évaluation (nombre d'essais, vitesse de travail...).

Conclusion. – Il s'agit d'une étude préliminaire, sur de petits échantillons ; l'évaluation par dynamomètre isocinétique peut être proposée à partir de l'âge de 14 ans car de nombreux paramètres sont liés à l'âge et la taille des sujets. Cependant, afin de mieux comprendre ces phénomènes, une étude longitudinale et comparative avec des échantillons plus importants est nécessaire.

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Mots clés : Isocinétisme ; Enfants ; Adolescents ; Force ; Tronc

1. English version

1.1. Introduction

Measurement of trunk muscle strength and endurance contributes to clinical evaluation of the LBP patient; however, their physiological and individual variability effectively complicates appraisal and comparison.

From a practical standpoint, muscle assessment methods using an isokinetic dynamometer are considered to be reliable and reproducible, with correlation coefficients between 0.93 and 0.99 for peak force values and between 0.91 and 0.96 for total workload values [6]. This dynamic assessment technique necessitates written as well as oral information from the patient, who is called upon to follow instructions throughout the procedure (means of installation, strapping, warm-up, initiation to training, etc.).

Most existing studies focusing on isokinetic assessment of trunk muscle function involve adult populations consisting in healthy subjects, LBP subjects [13,16,21,22,39] or operated subjects [15,21]. On the other hand, studies assessing trunk muscle strength in children and adolescents have remained scarce [1,2,24].

Through clinical trunk muscle endurance tests, Salminen et al. [33] evaluated the strength of the flexors and extensors in 15-year-old and observed diminished endurance in the LBP group compared to the control group. In the study by Sjolie and Ljunggren [37], diminished muscle strength in the spinal extensors and increased spinal mobility served as predictive factors for lower back pain in subjects between 14 and 16 years of age.

The studies conducted in children [43] have underscored a number of non-specific factors associated with LBP: relatively advanced age [24], female sex [1], past family LBP history [12], stiffness of the posterior muscle chain [24,27,28,34,35], vigorous physical activity [35,40], as well as the type and duration of seated position [44]. In a previous study [3] we showed that when using the Sorensen test, the spinal extensors were weaker in LBP patients than in members of the control group, and we wished to know if this remained the case from an isokinetic standpoint.

The main objective of this study consists in comparing by means of an isokinetic dynamometer the respective strength, power and endurance in healthy and LBP children with ages ranging from 11 to 16. The secondary objective, which pertains to the LBP population alone, consists in analyzing the relative influence of various clinical (pain intensity, hours of sports practice per week, muscle extensibility...) and radiologic (pelvic incidence, lumbar lordosis...) with regard to isokinetic performance.

1.2. Patients and method

1.2.1. Population

The population consists in two groups: a group of pre-teens and teens suffering from lower back pain (LBP) and a control group (CG), all of the subjects aged from 11 to 16 years.

Since growth is particularly pronounced during puberty, in order to take it into full account, both the healthy and the LBP children were divided into two distinct age groups, one from 11 to 13, and the other from 14 to 16 years old.

This study was approved by the ethics committee of the CMCR des Massues, Croix Rouge française.

1.2.1.1. The lower back pain population. The LBP population consists in pre-teens and teens from 11 to 16 years of age monitored in our child/adolescent unit, where they receive orthopedic treatment for back pain. A child is included in this category when his or her pain is chronic (more than 3 months), despite independent physical therapy carried out on a regular basis for more than 3 months. There exists no clearly defined protocol for management of LBP patients by private practitioners through physical therapy; in fact, a prescription merely indicates that their work has got to revolve around the recruitment of trunk muscles, generally with mild loss of lumbar lordosis correlated to pelvic incidence. In any event, pain intensity in these patients as measured by the visual analog scale (VAS) has not lessened with time and remains greater than 50%. The LBP children are evaluated prior to the outset of orthopedic treatment by means of codified clinical examination

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