A COMPARISON OF KNEE ALIGNMENT DEVICE AND DYNAKAD THIGH ROTATION OFFSETS

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Introduction

Most commercial gait analysis software packages use models that are similar to those devised by Kadaba, et al., (1990) and Davis, et al., (1991). These models depend on accurate placement of wands and markers on the subject. For example, misalignment of the thigh wand can cause errors in the knee flexion/extension axis, which can then propagate errors in kinematic data, especially in hip rotation. Since the thigh wand is difficult to properly align, the knee alignment device (KAD) was developed to aid in determining a static offset for an improperly placed thigh wand (Davis, et al., 1996). Recently Baker, et al., (1999, in press 1999) proposed another approach (DynaKAD) that assumes that an improperly placed thigh wand will cause artifact in the knee varus/valgus curve. The purpose of this study is to determine whether there is a correlation between the KAD thigh rotation offset and the DynaKAD thigh rotation offset.

Statement of Clinical Significance

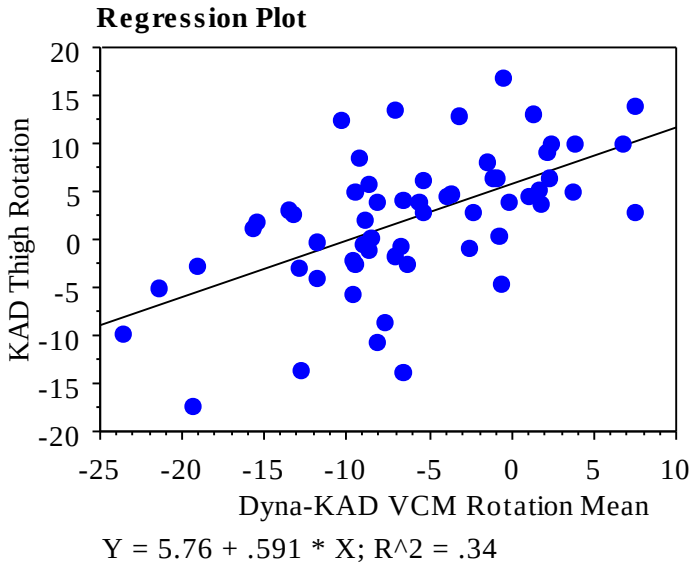
Improper placement of the thigh wand can propagate errors in kinematic data and may cause errors in clinical decision making.

Methods

Three clinicians with a minimum experience of 3 years performed computerized gait analysis on 59 normal children (mean age 9.5 ± 2.9) using a 6-camera VICON 370 system (Oxford Metrics) with two AMTI force plates. Thirteen reflective markers were placed on the lower extremities in accordance with the model described by Vicon Clinical Manager (VCM). For each subject, a static trial was collected using the knee alignment device (KAD) before the dynamic trials. Static and dynamic data were processed with VCM. For data analysis purposes, one side was randomly chosen and three representative trials for each subject were selected by the clinician. The static KAD thigh rotation offset (KTR) was recorded for each subject. The three dynamic trials were then re-processed with DynaKAD using Bodybuilder (Oxford Metrics). The VCM DynaKAD thigh rotation offset was extracted (DTR) and averaged for the three selected trials. An unpaired t-test was performed to determine if a statistically significant difference for KTR and DTR existed between clinicians. A simple linear regression was performed to determine any correlation between KTR and DTR. The difference between KTR and DTR was obtained (KDD) for each subject.

Results

Since no statistical difference was found between clinicians for each of the variables ($p > 0.116$), all subjects were grouped together. For the group, KTR had a mean of 2.19° ± 7.1 and DTR had a mean of -6.03° ± 7.0. KDD had a mean of 8.2° ± 6.5 with a minimum of -7.1° and a maximum of 22.9°. A graph of the regression is shown below (R^2=0.34).



Discussion

Differences in thigh rotation offset were identified with the two methods described. The KAD thigh offset tended toward internal rotation while the DynaKAD tended toward external rotation. Assuming one method is the gold standard, maximum errors of up to 23° could be generated. These results would have significant implications in clinical interpretation when determining whether to perform a femoral osteotomy.

Both methods have their limitations. The lack of correlation between the offsets would imply a nonsystematic error and that each method is potentially measuring the rotation differently. It is extremely difficult to assess which method yields the most accurate measure of thigh rotation offset. Stout, et al., (1996) showed that proper and consistent placement of the KAD is critical to accurate rotation data. The DynaKAD makes some assumptions about the knee varus/valgus signal which may not work for some clinical patients. Further study must be done to determine the most accurate method for thigh rotation offset.

References

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Acknowledgements

The authors wish to thank all of the subjects that volunteered and the clinical staff of the Motion Analysis Lab.