Is Lower Limb Joint Proprioception Systemic?

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INTRODUCTION

Proprioception, or joint position sense, provides feedback to the central nervous system that assists in appropriate muscle coordination during joint motion. Poorly controlled joint motion may lead to abnormal joint forces which are thought to be a risk factor for osteoarthritis (OA) in certain joints such as the knee. Proprioception decreases with age [1] and is further decreased in persons with knee OA [2] but we do not know if poor proprioception is a cause or effect of the disease [3]. It is also not known if proprioception is systemic across all joints.

If proprioception is systemic, then young and elderly persons will have different proprioceptive scores at all joints but the ratio of one joint to another will be similar regardless of age. If this were the case, we might be able to resolve the cause-effect relationship between proprioception and OA. The purpose of this study was to compare the ratio of ankle to knee proprioception between young and elderly group.

METHODS

Ankle and knee proprioception were tested on 15 young (24 ± 4 years) and 14 elderly subjects (70 ± 4 years). Active to active angle reproduction (AR) was tested twice at each of 30, 45 and 60 degrees of knee flexion. The error between experimenter positioning and subject repositioning was averaged across all trials. Threshold of movement detection (TD) tests were performed at a knee angle of 45 degrees with an angular speed of 0.3 deg/sec. The subject signaled when they detected their leg moving and could correctly indicate the movement direction. The range of motion (ROM) before signaling was averaged across 5 flexion and 5 extension trials. Repeatability of both tests was assessed on 10 subjects over two separate days. The ankle TD score was divided by the knee TD score to determine the ankle:knee ratio. An AR ankle:knee ratio was also calculated. For all tests the subjects were blindfolded and listening to music to reduce information received from other sources. T-tests were used to determine differences between groups on all variables.

RESULTS AND DISCUSSION

Repeatability testing showed that the AR test was not consistent (ICC < 0.6) and consequently there were no differences on the ankle and knee AR scores or the AR ankle:knee ratio between the young and elderly (Table 1). The TD test was repeatable (ICC > 0.8) and the elderly had an increased ROM before movement was detected (Table 1) at both the ankle and the knee. There were no differences between the groups on the TD ankle:knee ratio variable.

The AR tests at the knee and ankle used protocols similar to those in the literature and also used different equipment at each joint, suggesting that the lack of repeatability was not due to equipment or the joint. Agreeing with the literature, the TD scores showed that proprioception acuity decreased at both the ankle and knee with increased age [1]. The TD ankle:knee ratio was not different between the age groups suggesting that the decline in proprioception is similar at both joint. This lends support to the notion that at least some forms of proprioception may be systemic.

This information may shed some light on the spectrum of results collected from persons with knee OA. We expect the proprioceptive test scores from OA knees to be worse than those from aged-matched controls. Since the ankle is seldom affected by OA, if subjects with knee OA also have poor ankle proprioception, we can assume that poor proprioception preceded the disease. If the ankle score is normal, then we can assume that the poor knee score resulted from the disease process.

CONCLUSIONS

Active to active angle reproduction was not reliable at either the ankle or the knee. Both the ankle and knee threshold of movement detection scores were worse for the elderly but the ratio between the ankle and knee was not different between the age groups. These results suggest that some aspects of proprioception may be systemic.

REFERENCES

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ACKNOWLEDGEMENTS

Motor Performance Laboratory, School of Rehabilitation Therapy, Queen's University.

Table 1: Proprioception test scores.

	Active to Active Angle Reproduction (AR)			Threshold of Movement Detection (TD)		
	Ankle (deg)	Knee (deg)	Ankle:Knee	Ankle (deg)	Knee (deg)	Ankle:Knee
Young	**2.2 ± 1.2**	**3.3 ± 1.6**	**0.88 ± 0.7**	**0.9 ± 0.4***	**0.62 ± 0.3***	**1.53 ± 0.6**
Elderly	**1.8 ± 1.0**	**3.9 ± 1.7**	**0.59 ± 0.5**	**1.4 ± 0.4***	**0.93 ± 0.3***	**1.60 ± 1.0**

* A significant difference exists between the young and elderly ($p < 0.01$).