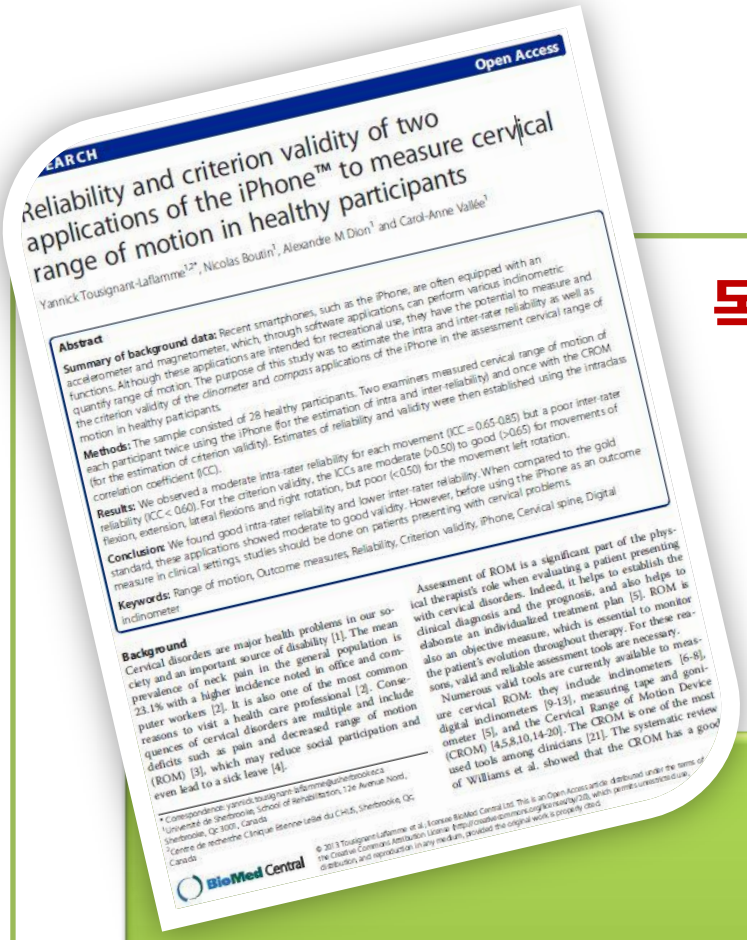
KEMA
Kinetic Ergocise based on Movement Analysis

Interesting Articles for KEMA Members



Open Access

RESEARCH

Reliability and criterion validity of two applications of the iPhone™ to measure cervical range of motion in healthy participants

Yannick Tousignant-Laflamme[1,2*], Nicolas Boutin[1], Alexandre M Dion[1] and Carol-Anne Vallée[1]

Abstract

Summary of background data: Recent smartphones, such as the iPhone, are often equipped with an accelerometer and magnetometer, which, through software applications, can perform various inclinometric functions. Although these applications are intended for recreational use, they have the potential to measure and quantify range of motion. The purpose of this study was to estimate the intra and inter-rater reliability as well as the criterion validity of the clinometer and compass applications of the iPhone in the assessment cervical range of motion in healthy participants.

Methods: The sample consisted of 28 healthy participants. Two examiners measured cervical range of motion of each participant twice using the iPhone for the estimation of intra and inter-reliability) and once with the CROM (for the estimation of criterion validity). Estimates of reliability and validity were then established using the intraclass correlation coefficient (ICC).

Results: We observed a moderate intra-rater reliability for each movement (ICC = 0.65-0.85) but a poor inter-rater reliability (ICC < 0.60). For the criterion validity, the ICCs are moderate (>0.50) to good (>0.65) for movements of flexion, extension, lateral flexions and right rotation, but poor (<0.50) for the movement left rotation.

Conclusion: We found good intra-rater reliability and lower inter-rater reliability. When compared to the gold standard, these applications showed moderate to good validity. However, before using the iPhone as an outcome measure in clinical settings, studies should be done on patients presenting with cervical problems.

Keywords: Range of motion, Outcome measures, Reliability, Criterion validity, iPhone, Cervical spine, Digital inclinometer

Background

Cervical disorders are major health problems in our society and an important source of disability [1]. The mean prevalence of neck pain in the general population is 23.1% with a higher incidence noted in office and computer workers [2]. It is also one of the most common reasons to visit a health care professional [2]. Consequences of cervical disorders are multiple and include deficits such as pain and decreased range of motion (ROM) [3], which may reduce social participation and even lead to a sick leave [4].

Assessment of ROM is a significant part of the physical therapist's role when evaluating a patient presenting with cervical disorders. Indeed, it helps to establish the clinical diagnosis and the prognosis, and also helps to elaborate an individualized treatment plan [5]. ROM is also an objective measure, which is essential to monitor the patient's evolution throughout therapy. For these reasons, valid and reliable assessment tools are necessary. Numerous valid tools are currently available to measure cervical ROM: they include inclinometers [6-8], digital inclinometers [9-13], measuring tape and goniometer [5], and the Cervical Range of Motion Device (CROM) [4,5,8,10,14-20]. The CROM is one of the most used tools among clinicians [21]. The systematic review of Williams et al. showed that the CROM has a good

* Correspondence: yannick.tousignant-laflamme@usherbrooke.ca
[1]Université de Sherbrooke, School of Rehabilitation, 12e Avenue Nord, Sherbrooke, QC J1H 5N4, Canada
[2]Centre de recherche Clinique Etienne-Lebel du CHUS, Sherbrooke, QC, Canada

© 2013 Tousignant-Laflamme et al.; licensee BioMed Central Ltd. This is an Open Access article distributed under the terms of the Creative Commons Attribution License (http://creativecommons.org/licenses/by/2.0), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

BioMed Central

목뼈 움직임 각도 측정 좀 더 편리할 수 있을까??

Reliability and criterion validity of two applications of the iPhone™ to measure cervical range of motion in healthy participants.

J Neuroeng Rehabil. 2013 5;10(1):69.

“Cervical range of motion (ROM)”

목뼈의 ROM 측정은 목뼈 손상이

있는 대상자를 평가함에 있어서 중요한 요소라고 할 수 있다.

목뼈 ROM 측정은 임상적인 진단과 예후 파악에

도움이 되고, 개인에 맞춘 치료 계획 설립을 용이하게 한다.

목뼈 ROM은 치료를 통한 환자의 평가에 객관적인 자료가 되기

때문에, 측정에 쓰이는 도구는 정확하고 신뢰할 수 있어야 한다.

그렇다면, 목뼈 ROM 측정을 위해서 쓰이는 도구는 어떤 것

들이 있을까?

KEMA

Kinetic Ergocise based on Movement Analysis

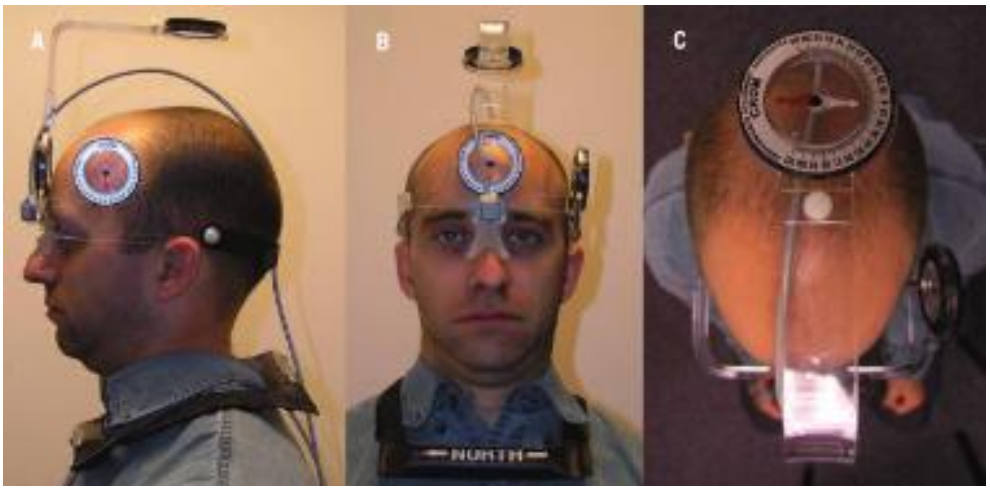
일반적으로 목뼈 ROM 을 측정하기 위해서 다양한 도구를 사용해왔고, 그것을 이용해 많은 연구가 이뤄져 왔다.

1. Digital inclinometer
2. Inclinometer
3. Goniometer
4. CROM (Cervical Range Of Motion Device)

대부분의 연구가 목뼈 ROM 의 측정에서 신뢰도와 타당도를 연구 하였다. CROM 은 가장 신뢰할 수 있는 X-RAY 와의 비교에서 근접한 결과와 신뢰도를 보였다. 하지만 이러한 도구는 상당히 고가의 장비이기 때문에 쉽게 적용하기에는 제한이 있었다.

그렇다면, CROM 과 비교하여 좀 더 편리하고 쉽게 적용할 수 있는 도구는 없을까?

KEMA
Kinetic Ergocise based on Movement Analysis



그림에서 보이는 것과 같은 CROM 을 이용하여 목뼈의 flexion/extension, side bending 그리고 rotation 에 대해서 스마트폰과 비교하고, 같은 측정자와 다른 측정자 사이의 값도 비교하였다.

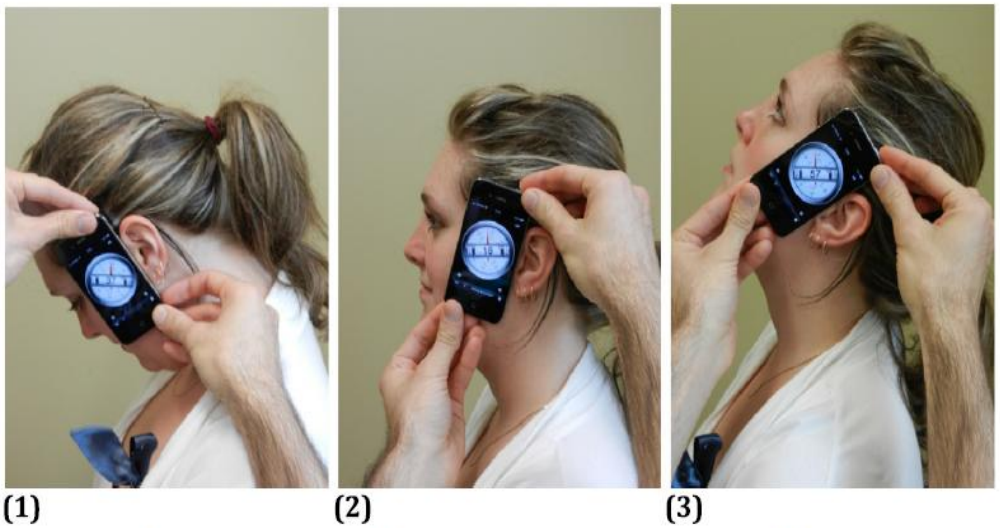


Figure 1 Position of the iPhone for the measurement of flexion and extension. (1) Position at end range of flexion. (2) Starting position. (3) Position at end range of extension. The side of the iPhone is aligned with the ear insertion to the head.

Flexion 과 extension measurement 시에는 스마트폰을 귀에 정렬하여 측정하였고, clinometer 라는 어플리케이션을 사용하였다.

KEMA
Kinetic Ergocise based on Movement Analysis

(1) (2)

Figure 2 Position of the iPhone for the measurement of right lateral flexion. (1) Starting position. (2) Position at end range of right lateral flexion. The iPhone's level is aligned with the corner of the eye.

Side bending measurement 시에는 스마트폰을 눈의 위치에 정렬하여 측정하였고, clinometer 라는 어플리케이션을 사용하였다.

(1) (2)

Figure 3 Position of the iPhone for the measurement of right rotation. (1) Starting position. (2) Position at end range of right rotation. iPhone's cover is fixed on the head, compass aligned in front with the nose.

Rotation measurement 시에는 스마트폰을 transverse plane 에서 머리 정중앙에 위치하여 측정하였고, Compass 라는 내장되어 있는 어플리케이션을 사용하였다.

KEMA
Kinetic Ergocise based on Movement Analysis

이 연구에서 CROM 과 스마트폰을 이용하여 목뼈의 ROM 을 비교했을 때 다음과 같은 결과를 보였다.

스마트폰을 이용하여 목뼈 ROM 측정 시 높은 측정자 내 신뢰도(good reliability)를 보였지만, 측정자 간 신뢰도(poor reliability)는 낮은 수준을 보였다.

CROM 과의 비교에서는 frontal 그리고 saggital plane 에서는 중간에서 높은 단계의 수준(moderate~good validity)을 보였다. 그러나 transverse plane 에서는 낮은 수준(poor validity)을 보였다.

Table 1 Reference values of the interpretation of ICCs

		Good	Moderate	Poor
ICC	Reliability	≥0.75	0.40-0.75	≤0.4
	Validity	>0.65	0.50-0.65	<0.50

따라서 CROM 을 대신하여 목뼈 ROM 을 측정하기에는 스마트폰을 쓰는 것이 모두 부분에서 정확하지 않았다.

그러나 "측정자가 같을 경우 목뼈 ROM 재검사를 시행했을 때 높은 측정자 내 신뢰도를 보였고,
frontal 그리고 saggital plane 에 한하여 CROM과 비교했을 때 중간에서 높은 단계의 타당도를 보였다."

이 결과를 참고하여 목뼈 ROM 측정에 부분적으로 적용이 가능하다는 것을 알 수 있을 것이다.

-KEMA 책임 연구원 전인철-

-문의사항은 KEMA 홈페이지 기사에 댓글로 남겨주세요-

KEMA
Kinetic Ergocise based on Movement Analysis