THE RELATIONSHIP BETWEEN LUMBAR PROPRIOCEPTION DEFICIT AND THE ADDICTION OF SMARTPHONE USE IN PATIENTS WITH CHRONICMECHANICAL LOW BACK PAIN: A CROSS-SECTION STUDY

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Abstract:

Background: Excessive smartphone use has been associated with proprioception deficit in cervical spine, however, it is not clear whether this relationship exists in other spinal regions such as the lower back.Theobjective of the study wasto investigatewhether smartphoneaddictive useand duration until first use in the morning are associated withlumbar spine proprioception deficitin patients with mechanical chronic low back pain (CLBP).

Methods: Fiftypatients with mechanical CLBP were included in this study.Smartphone addiction score,usage duration and time to first use in the morning were collected from patients using a self-reported questionnaire and a face-to-face interview. Lower back proprioception deficit was assessed using the Biodex System 3 Pro Isokinetic Dynamometer.

Results:Ten males and 40 females with a mean age (± SD)of 22.4 (± 2.48) years and BMI mean (± SD)of23.7 (± 1.98) kg/m^{2}completed all measurements. Proprioception deficit was positively, weakly and non-significantly correlated with smartphone addiction,use duration and time to first use in the morning.

Conclusion: Lower back proprioception deficit is independent of smartphone usage duration and addiction in patients with mechanical CLBP.

Keywords: Chronic low back pain; Proprioception; Reposition error; Smartphone.

- **Introduction:**

Mechanical chronic low back pain (CLBP) is a popular dysfunction in adults.[1,2]Persistent painmay be associated with increased proprioception deficit,restricted back mobility and impaired function.[3–8]Consequently, patients and their families may suffer from substantial socioeconomic burden [9–12]

There are many risk factors for the development and progression of CLBP including demographic and work-related factors.[1,13–16] as well as the use of hand-held devices such as electronicdevices.[17,18]With the increased use of smartphone, altered and impaired musculoskeletal function have been reported.[19–21]For example, excessive smartphone use was associated with greatercervical proprioception deficit in patients with chronic mechanical neck pain.[22]Also, using smartphone while walking showed reducedback proprioception acuity in healthy adults.[23] However, the association between lower back proprioception deficit and smartphone use and addiction has never been studied in patients with CLBP. Therefore, the purpose of this study was to investigate whether lumbar proprioception deficit is related to smartphone addiction, use, and time to first use in patients with mechanical CLBP.

- **Material and methods:**

Study design

Across-sectionaltwo-testing sessionsstudy that was conducted at the Biodex isokinetic laboratory, Faculty of Physical Therapy, Cairo University, Egypt.At the period from May to December 2018. The study was approved by the local institutionalethical committee (P.T. REC/012/001875).

Participants

Fiftyyoung adultswithmechanical CLBP were enrolled. All patients had CLBP defined as pain in the back and gluteal area in the absence of radicular pain and known red flags such as history of cancer, infection, urinary or fecal incontinences.[24] Patients were included in the studyif their age ranged between18 to29 years old, BMI was less than 30 and if they had LBP for three months or more. All patients needed to be familiar with smartphone use for at least 1 year.Patients were excluded if they reported a history ofsystemic disorder affecting the spine (such as ankylosing spondylitis), spinal traumaorlumbosacral radiculopathy.[24]

Measurement procedures

After screening for eligibility, the purpose of the study and all testing procedures were explainedverbally before subjects were invited to participate in the study. Then,an informed consent was signed by all enrollees.Patientswere interviewed and the basic demographic information, the average duration of smartphone daily use and the duration until first smartphone use in the morning were collected using standardized questions through a face-to-face interview. Then, each participant was requested to complete the Smartphone Addiction Scale Short Version (SAS-SV). This questionnaire is a valid and reliable scalefor assessing the smartphone addiction.[25]It consists of 10 items, that are answered based on a 5-point Likert scale.The SAS-SV inquiries about smartphone interference with planned work and meetings, concentration in class, and during assignments or work. It also questions whether smartphone use causes wrist or neck

pain. It queries about person's ability to stand without smartphone, and whether he/she feels impatient while not holding it or thinks about it even when not in use. Moreover, the questionnaire asks whether the person will never stop using the smartphone even if it affects daily life, and whether the person frequently check smartphone for not to miss any notifications, and if the smartphone is used for a prolonged period than intended, and, finally, whether other people note the excessive use of the device by the person filling the questionnaire.[25]The SAS-SVtotal score ranges from 10 to 60 points; with scores greater than 34 indicate addiction.[25]

Proprioception deficit was measuredusing the Biodex isokinetic dynamometer system 3 pro (Biodex Medical Inc., Shirley, New York, NY, USA). Biodex dynamometer is a valid (ICC= 0.99) and reliable (ICC= 0.99)tool for assessing joint position sesne.[6,26]First, the dynamometer was calibrated as described in the system's manual.Then,eachparticipant was asked to sit on the dynamometer's back extension chair,with the lower back rested against the lumbar pad and feet rested on the footpad. Participant's upper trunk, thighs andknees were secured in place using straps and belts. Then, the lumbar range of motion was identifiedand entered into the Biodex'ssoftware; startingfromzero erect neutral sitting with hips flexed 90° to maximum trunk flexion.Testing was then done with the target angle set at 30° flexion.[6,27]

A trainingsession on all testing procedures was given beforethe actual data collectionstarted. Lumbar proprioception was measured in terms of repositioning error angle, which is the difference between reached and targeted angles.[6,27] Three trials were done and the average was calculated. Testing took place whileparticipants were blindfolded, and the researcher did not provide any verbal feedback. Testing started by asking the participant to actively flex the trunk tillthe dynamometer stopped the movement upon reaching the target 30° flexionangle. Thisposition was held for 5 secondsto enable the participant frommemorizing itfor

a precise reproduction later on. Then,the participant actively extended the back tothe starting zero position beforehe/she re-flexed the trunk at a speed of 5°/sec.Once the target position was reached, theparticipant pressed the hold button.

Data analysis

All data were collected and tabulated in an excel sheet before they were analyzed using the SPSS version 21 (IBM incorporation, Illinois, USA).The angle of repositioning error and addiction scorewere presented as mean ± standard deviation (SD). Smartphone use and time to first use were expressed as a count (percentage). Pearson's correlation was employed to examine the association between the angle of repositioning error and smartphone addiction score, use duration and time to first use.Significant level was set at $p<0.05$ throughout all analyses.

- **Results**

Fifty patients were included in this study,10 males (20%) and 40 females (80%). The mean (± SD) age was 22.4 (± 2.48)years, BMIwas 23.7(± 1.98) kg/m^2 and smartphone addiction score was 35(± 10).

The average daily smartphone use durationvaried among participants;13 (26%) used smartphone for more than 6 hours, 6 participants (12%) used it for 5 - 6 hours, 19 patients (38%)used the phonefor 3-4 hours, 10 participants (20%)used it for 1-2 hours,and 2 participants (4%) used it between 11 - 60 minutes.

Thirtypatients (60%) used smartphonewithin 5 minutes of waking up and 14 participants (28%) within 6-30 minutes. The remainingsix participants(12%) used their phones after an hour or more of rising up.

The angle of repositioning error showed non-significant weak positive correlations withsmartphone addiction score (r =0.19, P>0.05), smartphone use duration (r=0.13, P>0.05) and the duration until first use in the morning (r=0.03, P>0.05) (Table 1).

Table 1: Pearson's correlation coefficient between the angle of repositioning error and smartphone addiction score, duration of smartphone use and duration until first use in the morning

	Smartphone addiction score		**Duration of smartphone use**		**Duration until first use in the morning**	
	R	**P-value**	**R**	**P-value**	**r**	**P-value**
The angle of repositioning error	0.19	0.18	0.13	0.37	0.03	0.85

- **Discussion**

The purpose of this study was to investigate the association betweenproprioception deficit (as measured by the angle of repositioning error) and smartphone addictive useand duration until first use in the morning in patients with mechanical CLBP.The findings of this study failed to provide evidence to support that smartphone use duration and addiction are associated with lumbar proprioception deficit in patients with CLBP. In this study, no tasks were done, but rather

patients were requested to evaluate their addictive use of smartphone based on self-reportedquestionnaire and a face-to-face interview.

The method used to evaluate smartphone use duration considered patients' own estimate of daily use, however, it did not account for the continuous usage duration. Patients may have used the smartphone over short-interrupted periods, minimizing the accumulative effect of continuous use. Moreover, the questionnaire used did not consider the assumed posture during use. Patients may have adapted comfortable postures or frequently changed their position while using the device to minimize the adverse effect on back and, hence, could have protected themselves from the drawbacks of prolonged use.[28,29]

Literature studying the association between smartphone use and back function are scarce. Only Yoon et al. (2015) investigated the association between phone use and back function. They reported a significantdifference of back repositioning errorafter using the phone for textingwhile walking. The results of Yoon and his colleagues contradict with the current study findings. However, differences in the methodology between the two studies could explain the contradiction in findings. First, Yoon's study was conducted on normal healthy adults, whereas patients with CLBP were recruited in this study; second, In Yoon's study, participants textedwhile walking, whichis a dynamic task requiring more concentration and activation of back stabilizers.[30]Third, texting while walking was proven to negatively affect gait kinematics[31], which could be attributed to the activation of postural musclesin order to maintain balance.[23]

A few studies investigated the association and smartphone use in the cervical spine. For example, Lee and Seo (2014) reported that smartphone addictionwas positively correlated with cervical reposition error in young adults and, hence, proprioception deficit. [32]Moreover, Park et al. (2017)investigated the effect of smartphone use on neck pain in young adolescents and found

that neck pain tends to increase following smartphone use.[33]Further, Kim and Koo (2016) reported increased neck pain and fatigue of erector spinae and upper trapezius muscles.[19]However, It should be emphasized that the cervical spine tends to be more dramatically affected by smartphone use as patients adapt a more flexed neck position as duration of smartphone use increases. [34]

To authors' knowledge, this is the first study to investigate the association between proprioception deficit and smartphone addictive use in patients with CLBP. However, a few limitations exist. First, smartphone addiction and usage wereevaluated based on self-reported average values and not objective measures. Such reporting may be affected by the ability of patient to remember and precisely estimate the duration. Second, this is an observational study that has inherited bias such as the recall bias and its inability to explain cause-effect. Third, only active proprioception deficit was measured in one range. Future studies are recommended to conduct prospective cohort longitudinal studies with adequate follow-up to confirm these findings. Further, researchers are recommended to measure proprioception deficit in other trunk motions and ranges.

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العلاقة بين عجز المستقبلات الحسية العميقة في الفقرات القطنية وإدمان استخدام الهواتف الذكية في مرضى آلام أسفل الظهر الميكانيكي المزمن.: دراسةمسحية

خلفية: ارتبط استخدام الهاتف الذكي المفرط معتغير في حدة في المستقبلات الحثية العميقةفي الفقرات العنقية، ومع ذلك، فإنه ليس من الواضح ما إذا كانت هذه العلاقة موجودة في مناطق أخرى في العمود الفقري مثل أسفل الظهر أم لا. هدف البحثهوالتحقق من وجود ارتباط بين إدمان الهواتف الذكية واستخدامها مع عجز المستقبلات الحسية العميقة فيالمنطقة القطنية من العمود الفقري في مرضى آلام أسفل الظهر الميكانيكي المزمن.

الطريقة:تضمنت الدراسة خمسون مريضا يعانون من آلام أسفل الظهر الميكانيكي المزمن. تم حساب درجة إدمان الهاتف الذكي، ومدة الاستخدام ووقت أول استخدام للهاتف الذكي في الصباح من المرضى باستخدام استبيانًا تم ملئه ذاتيًا اثناءمقابلة شخصية وجهًا لوجه مع المريض. تم تقييم عجز استقبال الظهر السفلي باستخدام جهازبيوديكس ايزوكينتك

النتائج:ارتبطت عجزالمستقبلات الحثية العميقةارتباطاً ضعيفاًوغير مهم احصائياً مع إدمان الهواتف الذكية،ومدة الاستخدام ووقت أول استخدام للهاتف الذكي في الصباح.

الخلاصة:عجزالمستقبلات الحثية العميقة لأسفل الظهر مستقل عن مدة استخدام الهاتف الذكي وإدمانه والمدةحتى أول استخدام له في الصباح في مرضى آلام أسفل الظهر الميكانيكي المزمن.

الكلمات الدالة: آلام أسفل الظهر الميكانيكي المزمن/ الهواتف الذكية/ المستقبلات الحثية العميقة/إدمان الهواتف الذكية