ORIGINAL RESEARCH PAPER

Volume-9 | Issue-5 | May-2020 | PRINT ISSN No. 2277 - 8179 | DOI : 10.36106/ijsr

INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

EFFECT OF SMARTPHONE ADDICTION ON PROPRIOCEPTION OF THUMB AND INDEX FINGER IN THE SMARTPHONE ADDICTS

Physiotherapy

Palak Vakil — Physiotherapy Research Intern, K. J. Somaiya College of Physiotherapy, Sion, Mumbai, India.

Anjali Puntambekar* — Associate Professor,Department of Musculoskeletal Rehabilitation, K. J. Somaiya College of Physiotherapy, Sion, Mumbai, India. *Corresponding Author

ABSTRACT

Background: Smartphone has been an essential part of everyone's life. In young adults, due to their developing musculoskeletal structures and they are growing tendency to use smartphones, these exposures are causing repetitive strain injuries in their fingers and thumb. As a consequence of the injury to the musculotendinous tissues, there is disruption of the joint proprioceptors located at the soft tissues of a joint, thus may lead to reduced joint position sense.

Method: 58 young adults within the age group 19-34 years were categorized into 2 groups, smartphone addicts and non-addicts using Smartphone addiction scale-short version. The proprioception of both the hands was assessed using pinch aperture proprioception.

Conclusion: The result showed that the dominant hand of smartphone addicts showed the highest measure of degree of error (3.22±1.72), which may lead to impaired fine activities with the pinch grip.

KEYWORDS

Smartphone addiction, Repetitive strain injury, Pinch aperture proprioception.

1.INTRODUCTION

Smartphones are an integral part of daily living. The 2017 Global Mobile Consumer Survey stated that the maximum use of smartphones is in the age group of 18years to 24 years.There has been an increase in the use of smartphones for communication, gaming and internet browsing.[1]

In young adults, because of their developing musculoskeletal structures and they are growing tendency to use smartphones, these exposures are causing repetitive strain injuries in their upper extremities, especially fingers and thumb. The occurrence of hand, wrist, forearm, arm, and neck musculoskeletal disorders (MSD) has increased worldwide due to the continuous, forceful, low amplitude, repetitive use of handheld devices (HHD). Continuous repeated thumb and finger movements were also established as risk factors that could contribute to the thumb and their muscle disorders such as extensor pollicis longus tendinosis or myofascial pain syndrome in the hand.[2]

As a consequence of the injury to the musculotendinous tissues, there is disruption of the joint afferent located at the soft tissues of a joint. The primary ends of muscle spindles are responsible for the sense of position and movement of our limbs in the absence of visual information, and the secondary ends of spindles contribute to the sense of position while the tendon organs give us a sense of tension. At some, particularly the more distal joints, skin and joint afferents provide additional information. Thus, proprioceptive deficits are likely to occur and may manifest as reduced joint position sense. On the contrary, proprioceptive feedback has a crucial role in manipulating the finger and guiding them for performing various fine motor activities from the starting to the endpoints. The pinch aperture proprioception is important to perform a variety of tasks in the daily living and occupational fields. In fact, many studies have proposed the importance of proprioception in many manual tasks and its relevance in grip force management skills.[3]-[5]

Therefore, this study aimed to assess the effect of the overuse of smartphones on the index finger and thumb proprioception using the pinch aperture proprioception device. The device examines pinch aperture proprioception between the index finger and the thumb in a functional and clinically accessible way using the joint position reproduction. The pinch grip represents the complex nature of the grasping maneuvers involved in the majority of the manipulative tasks we perform during ADLs such as buttoning a shirt, holding a key, using a scissor, picking up small items, writing, and lifting objects with different weights.[3]

2. MATERIALAND METHODOLOGY

Approval by the institutional review board was taken before the research was initiated. All of the participants received informed written consent. The research was carried out at the Research lab of K. J. Somaiya College of Physiotherapy. It was a cross-sectional, comparative study. 58 young adults were given to fill Smartphone Addiction Scale- Short Version to find out the extent and severity of addiction. Based on the scores, the adult female and male are classified as 29 Group 1- smartphone addict (male SAS-SV score > 31 and female SAS-SV score > 33) and 29 Group 2- smartphone non-addict. Participants with current injury to the hand or upper extremity (less than six months), and any degenerative, inflammatory, musculoskeletal or neuromuscular conditions of the upper extremity or hand that affect the use of the extremity in dailyliving activities were excluded from the research.

2.1 Description of the Pinch aperture proprioception

The device used to test the proprioception of the pinchaperture involves a modified goniometer mounted to a cardboard box (4 x 17 x 10 cm; height, length and width respectively). Two rounded pads are attached to both ends of the goniometer arms, which act as index finger and thumb positioning for the participants.[3]

2.2 Description of the method

Then participants were asked to position their index finger and thumb tips along the perpendicular pads attached to the modified goniometer. The participants put their test hand on the table and were instructed to hold the wrist in a neutral position allowing for free movement of their index and thumb fingers. The test started with the examiner telling the subjects to close their eyes and move the tool to the starting point along with the participant's fingers, which is 30° pinch aperture; the examiner then adjusted the goniometer's arms to a 15 ° pinch aperture (target point). Finally, the subjects were directed to actively move the goniometer arms back from the starting point to the previously memorized target point (i.e., from 30 ° to 15 °) after 2 memorization tasks. On the data record sheet, the researcher wrote down all the actual target angles that the participants achieved during all 3 experiments. The primary outcome is the degree of error as compared to the actual target angles from the trials of the subjects.[3]

In the smartphone addict group, the sample population consisted of 26 females and 3 males, and 25 females and 4 males in the non-smartphone addict group.

Table 1: Demographic data

	Addicts	*Non-addicts*
1.Gender- Female	89.66% (26/29)	86.21% (25/29)
Male	10.34% (3/29)	13.79% (4/29)
2.Age (Mean/SD)	21.59/1.452	21.10/1.496
3.SAS-SV score (Mean/SD) Female	34.85/4.567	22.72/6.066
Male	38/3.606	24.75/4.573

3. RESULT

The data thus collected of 58 subjects, was statistically analyzed using GraphPad Instat3 software. Parametric test i.e. One-way Analysis of Variance -Paired t-test was used for the comparison of data between smartphone addict and non-addict groups for the data which passed the normality tests. Non-parametric test i.e. Mann-Whitney test was used for the data which did not pass the normality test. These tests were performed at a 5% significance level. The results are summarized in Table 2. The analysis suggests that there is affection of thumb and index finger proprioception in the dominant hand of the smartphone addicts as compared to the smartphone non-addicts (p value=0.0089). Although, there is no significant affection of index finger and thumb proprioception in the non-dominant hand among the two groups (p value=0.4456). Also, there is significant affection of thumb and index finger proprioception of the dominant hand as compared to the non-dominant hand in the smartphone addict population (p value=0.0016). There is no significant affection of thumb and index finger proprioception of the dominant hand as compared to the non-dominant hand in the non-smartphone addict population (p value=0.0856). Thus, to summarize the dominant hand of smartphone addicts showed the highest measure of degree of error (3.22+1.72).

Table 2: Summary of Statistical Analysis

Sr no.	Comparison	Mean	Standard Deviation	Test	P-value	Significance
1	Comparison between dmt hand of Grp 1 and 2	Grp 1: 3.22 Grp 2: 2.24	Grp 1: 1.72 Grp 2: 1.087	Mann-Whitney	0.0089	Significant
2	Comparison between non-dmt hand of Grp 1 and 2	Grp 1: 1.93 Grp 2: 1.88	Grp 1: 1.14 Grp 2: 1.28	Paired t-test	0.4456	Not significant
3	Comparison between dmt and non-dmt hand in Grp 1	Dmt: 3.22 Non-dmt: 1.93	Dmt: 1.72 Non-dmt: 1.44	Mann-Whitney	0.0016	Significant
4	Comparison between dmt and non-dmt hand in Grp 2	Dmt: 2.24 Non-dmt: 1.88	Dmt: 1.087 Non-dmt: 1.276	Mann-Whitney	0.0856	Not significant

*Grp: Group; Dmt: Dominant; Non-dmt: Non-dominant

4. DISCUSSION

The above results are in accordance with the disruption of proprioceptive receptors in index finger and thumb joints. They can be divided into slow and fast types. The fast receptors can react quickly to external stimuli and issue nerve impulses; these include the Pacinian corpuscles, whose main function is to sense movement during the process of acceleration or deceleration motion, and the start or end of the movement. Over time, the slow receptors continue to sense stimuli, including Ruffini corpuscles, Unmyelinated nerve endings, Golgi tendon organs, and muscle spindles, whose main function is to sense the change of position and correct positioning of joints.[14]

The proprioceptive feedback has a crucial role in manipulating objects between fingers during the everyday task of positioning of the arm, hand and fingers as well as guiding the movement from the starting to the ending points. A study on grip force control states that proprioception has a vital role in controlling the magnitude of grip forces and the stability of joints by updating anticipatory or online commands.[3]

According to this study, young adults with smartphone addiction have affection of proprioception in the dominant hand as compared to the dominant hand of non-smartphone addicts. This is attributed to the increase in the use of smartphones with sustained gripping and repetitive movements which leads to repetitive strain injury in the fingers and thumb. There is increased static loading and end range motion of the thumb during texting which predisposes to tendinosis of extensor pollicis longus muscle and bursitis.[2] The high-stress repetitive activities at the saddle joint of the thumb may cause inflammation and edema in the joints which predisposes to thumb osteoarthritis.[9] This leads to impairments in theintrafusal fibers of spindle muscles and in the tendon organs which leads to the affection of proprioception of the pinch grip in young smartphone addicts.[11] Also, the receptors and end organs within the capsule are damaged due to lax capsule and ligaments, caused by loss of cartilage and bone height and the release of lytic enzymes around the joint leading to decreasing proprioception perception.[10]

Moreover, the smartphone addicts showed a significant difference in the degree of error in joint reposition in their dominant hands as compared to their non-dominant hands. The primary causes may be due to enlargement of flexor pollicis longus (FPL) tendons on the dominant side compared with the non-dominant side of smartphone users and non-users. In addition, median nerve cross-sectional area (CSAs) also were significantly large on the dominant side of the high-smartphone-user group compared with the non-dominant side as showed in a study by Esra et al. This could be on the basis of the nature of smartphones users often hold the device with a single hand, which forces only their dominant hands' thumb to use the keys. Therefore, in high-smartphone users who have a habit of using single-handed smartphones, there is a possibility of enlargement of the FPL and median nerve. Nevertheless, previous studies have shown that pinch and tendon forces alter the tendon trajectory and add pressure to the carpal tunnel, which can be an underlying mechanism for the enlarged median nerves as well.[12],[13]

On the other side, the degree of error of the dominant and non-dominant hand of the non-smartphone addicts showed no significant difference. This helps justify that there is relevant significant affection of the dominant hand as compared to the non-dominant hand in the smartphone addicts.

The pinch aperture proprioception in the non-dominant hands of the smartphone addicts and non-addicts showed a similar measure of degree of error. Due to the given nature of smartphones, users often hold the device with a single hand, which forces only their dominant hands' thumb to use the keys.[15],[16]

Ultimately, due to musculoskeletal deficits leading to impaired proprioception of thumb and index finger affects the performance of fine motor activities in day to day life and also in the occupational fields.

5. CONCLUSION

This study shows that smartphone addiction can result in the affection of proprioception of index finger and thumb, which, in turn, leads to the affection of pinch grip activities. Therefore, smartphone addiction has an impact on the joint position sense of pinch grip movement of male and female young adults, which, in the long run, may result in impaired daily activities. It also shows the hand functions can also be affected after sustained smartphone use.

6. SUGGESTIONS

- Similar studies can be carried out in multi-centric areas.
- The effect of gender on proprioception in smartphone addiction can be assessed.
- Long term effect of smartphone use on proprioception can be assessed.
- Complex and novel devices can be used to assess the proprioception of thumb and index finger in smartphone addicts.

REFERENCES

[1] Deloitte Global Mobile Consumer Survey 2017 – The Netherlandshttps://www2.deloitte.com/content/dam/Deloitte/nl/Documents/technology-media telecommunications/2017%20GMCS%20Dutch%20Edition.pdf.
[2] Priyal P. Shah, Megha S. Sheth (2018 Jun) Correlation of smartphone use addiction with text neck syndrome and SMS thumb in physiotherapy studentsInt J Community Med Public Health.;5(6):2512-2516.http://dx.doi.org/10.18203/2394-6040.ijcmph20182187.
[3] AbdalghaniYahya, Timothy von Behren, Shira Levine, Marcio dos Santos, (2018) Pinch aperture proprioception:reliability and feasibility study. J. Phy. Ther. Sci., 30: 734-740. https://doi.org/10.1589/jpts.30.734.
[4] Gandevia SC. (2011, Jan).Kinaesthesia:Roles for afferent signals and motor commands.Handbook of Physiology, section 12, Exercise: Regulation and Integration of Multiple Systems. New York: Oxford University Press. pp. 128–172. https://doi.org/10.1002/cphy.cp120104.
[5] Moberg E, (1958) Objective methods for determining the functional value of sensibility in the hand. J Bone Joint Surg Br, 40-B: 454–476. https://doi.org/10.1302/0301-620X.40B3.454.
[6] Dr. Dalia M KamelAbrarMoh'dBaqer Fatima Redha,(2003).Impact of Smart Phone Use on the Musculoskeletal System: A preliminary Study in Ahlia University Population.

Holizinger, LNCS. pp: 387- 397.
[7] Dr. BasavarajMotimath, Melissa Luis and Dr. DhavalChivate, (2017) Influence of Smartphone Addiction on grip and pinch strength in collegiate population – An observational study. International Journal of Advanced Research, 5(8): 1836-1841. http://dx.doi.org/10.21474/IJAR01/5249.
[8] EsraErkolInal,,KadirDemirci,, AzizeCentinturk,, Mehmet Akgonul,, and SerpilSavas, (2015, Aug). Effect of Smartphone overuse on hand function, pinch strength and the median nerve. Muscle and Nerve.; 52(2):183-8.https://doi.org/10.1002/mus.24695.
[9] Fernando Canillas, Alvaro Colino, and Pablo MenéndezCellular, (2014 Oct-Dec). Phone Overuse as A Cause for Trapeziometacarpal Osteoarthritis: A Two Case Report. J Orthop Case Reports; 4(4): 6–8. https://doi.org/10.13107/jocr.2250-0685.213.
[10] Barrett DS, Cobb AG, Bentley G (1991). Joint proprioception in normal, osteoarthritic and replaced knees. J Bone Joint Surg Br., 73: 53-56. https://doi.org/10.1302/0301-620X.73B1.1991775.
[11] Torres R1, Vasques J, Duarte JA, (2010 Jun). Knee proprioception after exercise-induced muscle damage.Int J Sports Med.31(6):410-5. https://doi.org/10.1055/s-0030-1248285
[12] Keir PJ, Wells RP, Ranney DA, Lavery W. (1997). The effects of tendon load and posture on carpal tunnel pressure. J Hand Surg Am;22: 628–634. https://doi.org/10.1016/S0363-5023(97)80119-0
[13] Keir PJ, Wells RP. (1999). Changes in geometry of the finger flexor tendons in the carpal tunnel with wrist posture and tendon load: an MRI study on normal wrists. ClinBiomech (Bristol, Avon);14:635–645. https://doi.org/10.1016/s0268-0033(99)00012-1
[14] Huihui Wang, Zhongqiu Ji, Guiping Jiang,Weitong Liu, MS,and Xibian Jiao, (2016 Dec).Correlation among proprioception, muscle strength, and balance J Phys Ther Sci.; 28(12): 3468–3472.https://doi.org/10.1589/jpts.28.3468
[15] Matthieu B. Trudeau, Justin G. Young, Devin L. Jindrich, Jack T. Dennerlein, (2012 Aug). Thumb motor performance varies with thumb and wrist posture during single-handed mobile phone use.Journal of Biomechanics, 45(14):2349-2354. https://doi.org/10.1016/j.jbiomech.2012.07.012
[16] Berolo S, Wells RP, Amick BC III. (2011). Musculoskeletal symptoms among mobile hand-held device users and their relationship to device use: preliminary study in a Canadian university population. Appl Ergon; 42:371–378.https://doi.org/10.1016/j.apergo.2010.08.010