Distal upper extremity disorders due to extensive usage of hand held mobile devices

Deepak SHARAN, Mathankumar MOHANDOSS, Rameshkumar RANGANATHAN, Jerrish A JOSE, Joshua Samuel RAJKUMAR

RECOUP Neuromusculoskeletal Rehabilitation Centre, Bangalore, India

Abstract. The aim of this study was to evaluate the risk factors and clinical features of upper extremity musculoskeletal disorders (MSD) in mobile device users. A report analysis which included 59 subjects between the ages of 5 to 56 years, who were diagnosed to have a MSD affecting the upper extremities was done. All the patients underwent rehabilitation using a sequenced protocol. All the subjects reported pain in the thumb and forearm with associated burning, numbness and tingling around the thenar aspect of the hand, and stiffness of wrist and hand. 24 subjects had symptoms on the right side; 12 on left and 13 had bilateral symptoms. Correlation was found between hand dominance and MSD. 33 subjects complained of onset of symptoms following extensive text messaging. All the subjects were diagnosed to have tendinosis of Extensor Pollicis Longus and Myofascial Pain Syndrome affecting the 1st interossei, thenar group of muscles and Extensor Digitorum Communis. 23 of the subjects were senior executives, among these 7 were CEO's of major multinational companies in India. All the subjects recovered completely following the rehabilitation.

Keywords. Hand Held Devices, Musculoskeletal Disorders, Mobile Devices

Introduction

Hand-held devices are those devices which are used for communication and entertainment purposes such as media, internet access and gaming. Also the multiple usability options available in the mobile phones encourage the users to engage most of his time in his hand-held device. The use of these hand-held devices is on the rise (Jonsson et al., 2011). Mobile phone users can able to communicate other than voice by a wide range of text button usage by means of SMS (short message service) , whats app, viber, line in, BBM (blackberry messenger) and social networking applications like facebook, twitter and skype. Texting is the most widely used mobile data service, with 74% of all mobile phone users worldwide being active users of it. According to BBC reports, almost 19 billion messages were sent per day using chat apps and 17.6 billion SMS messages in 2012. Literature reports an adverse impact on the physical and psychological health of the users of mobile and other information technology (Gustafsson et al., 2003). The incidence of musculoskeletal disorders of hand, wrist, forearm, arm and neck has been increasing all over the world due to prolonged, forceful, low amplitude, repetitive use of hand held devices (Eapen et al., 2010). Sustained and gripping and repetitive movements with the thumb and fingers have all been identified as risk factors which may lead to disorders of the thumb and thumb musculature in the forearm. The range of movements of the thumb varies according to the size of the mobile and orientation of the keys (Gustafsson et al., 2010). Published studies shows a relation between mobile design and anthropometry of the user ain causing discomfort and fatigue in hand, elbow and shoulder while using the hand-held

device (Chany et al., 2007). Studies have revealed a high incidence of musculoskeletal disorders of hand, wrist, fore-arm, arm and neck has been increasing all over the world due to prolonged, forceful, low amplitude, repetitive use of such devices. Additional factors include small spacing in the keypad, increased static loading, end-range motion of the thumb during texting and a difference in the muscle activity between individuals with and without musculoskeletal symptoms (Sengupta et al., 2007). Phrases have been coined such as 'SMS thumb', 'i-pod finger', 'blackberry thumb', 'wii injury' and 'nintenditis', however there are little evidence exists to support this association (Sophia et al., 2011; Koh., 2000). Although no epidemiological studies have been reported, case reports and laboratory studies indicate potential risks to musculoskeletal health as a result of mobile device usage. Hence, this study was done to evaluate risk factors and clinical features of the musculoskeletal disorders due to hand held devices.

2. Methodology

A report analysis which included 59 subjects between the ages of 5 to 56 years, who were diagnosed to have a MSD affecting the upper extremities, was done. Reports of a tertiary level rehabilitation centre in Bangalore, India were reviewed for the subjects reporting pain in their upper extremities following extensive usage of hand held devices like mobile phones, tablets, iPods, etc. The collected reports were analysed. All the subjects in the report were examined, diagnosed and treated in tertiary level rehabilitation clinic between the years of 2005 to 2012. The subjects with symptoms were all clinically examined according to a published protocol by a physician. After the diagnosis and assessment, all the patients underwent rehabilitation using a sequenced protocol. Visual Analog Scale (VAS) was used to assess the pain levels of study subjects before and after the rehabilitation. The sequenced protocol included a four phase model based on the pain level, as described in Table 1.

Table 1: Sequenced Rehabilitation Protocol – Four phase model

PHASES	**PHASE I**	**PHASE II**	**PHASE III**	**PHASE IV**
LEVELS	**VAS : > 8**	**VAS: <8-5**	**VAS: < 5-2**	**VAS: <2**
GOALS	Pain relief Restoration of flexibility	Ergonomic modification Hand function re-training	Postural retraining Strengthening	Improve ADL Maintenance of function

Phase I included Soft tissues Mobilisation techniques (Trigger point Release, myofascial release, positional release technique, muscle energy technique); gentle grade 1 and 2 mobilisation of the upper extremity for pain; range of motion exercises for the elbow, wrist and finger joints and electrotherapy modalities such as ultrasound, Low Level Laser Therapy, Contrast bath and Kinesio taping.

Phase II included gentle active and passive stretching of the muscles of upper extremity especially hand; Hand exercises inside a water tub (Hydrotherapy); EMG Biofeedback for retraining the muscle during working with the hand-held device and ergonomic modification.

Phase III included strengthening of the upper extremity muscles especially the hand

and postural awareness and retraining.

Phase IV included improving the hand activities in activities of daily living; maintenance of the regained function by involving in leisure and sport activities and home program was prescribed.

The data were analyzed to identify the risk factors and clinical manifestations of text message injuries.

3. Result

Among the 59 participants, 47 were male and 12 were female. The median age was 34 years. The type of hand held device used by the participants are presented in Table 2.

Table 2: Type of Users

TYPE OF MOBILE DEVICE	USERS	PERCENTAGE
Blackberry	21	35.59
Other Smart phones	29	49.15
Ordinary phones	6	10.16
Gaming devices	3	5.08

Most of the subjects were using Smart phones (49.15%), followed by Blackberry (35.59%) and others used ordinary mobile phone (10.16%). Three of the subjects were using a gaming device (5.08%). Among them, 66.67% of the users who reported MSD of the present study were primary level managers. 38.9% of the subjects (n=23) were senior executives of major multi-national companies.

Clinical assessment showed that for majority of the individuals, right side was more affected (85.19%) when compared to the left side and bilateral involvement, which are displayed in Figure 1. The common symptoms reported by the subjects during examination were pain in the thumb and forearm with associated burning, numbness and tingling around the thenar aspect of the hand with stiffness of wrist and hand.

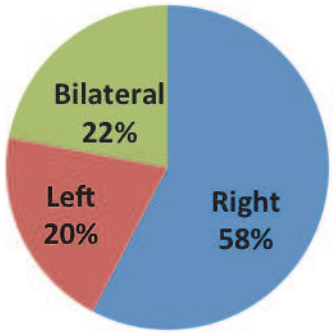

Figure 1: Affected Side of the body

All the subjects (n=59) were diagnosed to have tendinosis of extensor pollicis longus and

myofascial pain syndrome affecting the 1st interossei, thenar group of muscles and extensor digitorum communis. The associated co-morbidities mostly were myofascial pain syndrome (due to an exquisitely sensitive knot within the muscle belly) of neck and upper back (70.37%) and thoracic outlet syndrome (compression of the nerves and blood vessels between the base of the neck and armpit) (51.85%). The co-morbidities are presented in Table 3.

Table 3: Associated Co-morbidities reported among the subjects

Associated Disorders noted	Number of subjects
Myofascial pain syndrome of Neck and Upper back	19
Thoracic outlet syndrome	14
Fibromyalgia syndrome	7
Hypothyroidism	2
Wrist tendinitis	4
De Quervain's	2

A significant positive correlation was found between the hand dominance and occurrence of upper extremity musculoskeletal disorders in the study individuals using hand-held devices ($p<0.01$). After the treatment the VAS scale showed significant difference in decrease pain level after the rehabilitation following a sequenced protocol intervention ($p<0.01$).

4. Discussion

This report analysis has described the common clinical features noted in MSD due to hand held devices and the outcome of rehabilitation. Earlier studies have revealed that while texting in mobile keypad the thumb covers motions in planes of extension, flexions, abduction-adduction and opposition. These motions occur simultaneously in three dimensions and as a result it becomes difficult to measure the kinematics of thumb (Ong, 2009). Which is one of the main triggering factor for the development of tendinosis of extensor pollicis longus as reported in our study. Studies related to measurement of thumb postures during SMS texting were shown to be affected by the size of the mobile phone and movement axes of the thumb (Gustafsson et al., 2010; Ming et al., 2006) . This might have been a notable factor for our study subjects who used blackberry and other smart phones which are comparatively larger and hence ended up with the MSD problem. It was also established that the thumb worked near the extreme range of motion, may contribute to the development of musculoskeletal disorders and this phenomena is common in the use of mobile phone while texting. Static loading by constant holding of the hand-held device and an overuse of the hand muscles are a definitely possibility causing the development of myofascial pain syndrome of hand and forearm muscles (Eapen et al., 2010). Nintendo thumb, Gamer's grip, Nintendinitis is a video game related disorder as similar to the disorders occurring in text messaging, affecting the hands. Movement of fingers are quite

similar as in typing the text on mobile screen. Symptoms are like blistering, paraesthesia and swelling of the thumbs. This may affect any finger and it may lead to tendinitis, bursitis, and so on. Repeated tapping of keys while computing also leads to such ailments. In the present study similar results obtained and it is according to the available literature (Koh., 2000).

A study showed that postures and the type of mobile phone task affected muscle activity and thumb positions. In the same study they reported that females compared to males had higher muscle activity in the extensor digitorum and the abductor pollicis longus when entering SMS messages and tended to have greater thumb abduction, higher thumb movement velocities and fewer pauses in the thumb movements (Gustafsson et al., 2010). On the contrary in our present study such differences were not present.

The present study was done on a relatively small sample size of fifty nine subjects. Therefore generalisation of the result is difficult. As the study results showed high prevalence of myofascial pain syndrome, thoracic outlet syndrome and fibromyalgia syndrome among the hand-held device users, a large sample size study is the need of the hour. It can be done on different types and designs of hand-held devices and different user characteristics to understand the problem in detail. This will pave way for recommending appropriate design of hand-held devices and improving user friendliness according to the anthropometry of the users. Also further identification of the pathogenesis of these disorders is needed so that a proper recommendation strategy can be formulated.

5. Conclusion

Even though the MSD due to hand-held devices can be rectified with proper rehabilitation, understanding the risk factors and prevention of these disorders are to be emphasised. Hand-held devices, that promotes the predominant usage of thumb while texting are associated with a higher prevalence of MSDs and hence the users are advised to select phones that are designed to permit typing with all the fingers and reduce the total duration of usage of the device.

References:

Rainie L. Pew Internet & American Life Project: Internet, Broadband, and Cell Phone Statistics. 2010Pew Research Center.

Jonsson P, Johnson PW, Hagberg M. Thumb joint movement and muscular activity during mobile phone texting – A methodological study. Journal of Electromyography and Kinesiology 2011; 21: 363-370.

Gustafsson E, Dellve L, Edlund M, Hagberg M. The use of information technology among young adults–experience, attitudes and health beliefs, Applied Ergonomics 2003; 34: 565-570.

Eapen C, Bhat AK. Prevalence of cumulative trauma disorders in cell phone users. Journal of Musculoskeletal Research 2010; 13: 137-145.

Gustafsson E, Johnson PW, Hagberg M. Thumb postures and physical loads during mobile phone use - a comparison of young adults with and without musculoskeletal symptoms. Journal of Electromyography and Kinesiology 2010; 20: 127-135.

Chany AM, William S, Marras D, Burr L. The Effect of Phone Design on Upper Extremity Discomfort and Muscle Fatigue. Human Factors 2007; 4: 602-618.

Sengupta A, Grabiner S, Kothari P, Martinez G. Ergonomic aspects of personal digital assistant (PDA) and laptop use. In: Proceedings of the Sixth International Scientific Conference on Prevention of Work-Related Musculo-skeletal Disorders 2007.

Sophia B, Richard P, Benjamin C. Musculoskeletal symptoms among mobile hand-held device users and their relationship to device use: A preliminary study in a Canadian university population. Applied Ergonomics 2011; 42: 371-378.

Koh TH. Ulcerative "nintendinitis": a new kind of repetitive strain injury, Med J Aust 2000; 173: 671.

Ong FR. Thumb motion and typing forces during text messaging on a mobile phone. 13th International Conference on Biomedical Engineering, IFMBE Proceedings 2009; 23: 2095-2098.

Ming Z, Pietikainen S, Hänninen O. Excessive texting in pathophysiology of first carpometacarpal joint arthritis. Pathophysiology 2006; 13: 269-270.