
Musculoskeletal Disorders Due to Hand-Held Devices: A Major Problem at Hand

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ABSTRACT

The aim of this study was to evaluate the risk factors and clinical features of upper extremity MSDs in hand-held device users. A retrospective report analysis was conducted on 59 subjects (47 males and 12 females) between the age of 5 to 56 (Median – 34) years, who were diagnosed to have a MSD affecting the upper extremities. Medical records of the subjects from a tertiary level rehabilitation centre in India from 2005-2012 were analyzed. All the subjects reported pain in their upper extremities following extensive usage of hand held devices and were examined and diagnosed to have MSD by an experienced Orthopaedic Physician. After the assessment and diagnosis, 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. 34 subjects had symptoms on the right side, 12 on left side and 13 had bilateral symptoms. Correlation was found between hand dominance and the occurrence of upper extremity MSDs. 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. Co-morbidities were Myofascial Pain Syndrome of the neck and upper back and Thoracic Outlet Syndrome. 23 of the subjects were senior executives. All the subjects recovered completely following the rehabilitation. Hand-held devices, that promotes the predominant usage of thumb while texting are associated with a higher prevalence of MSDs and thereby the users are advised to select phones that are designed to permit typing with all the fingers. Treatment using a sequenced protocol showed significant level of improvement in this condition.

INTRODUCTION

Hand-held devices are those devices which are used for communication and entertainment purposes such as media, internet access and gaming¹. These include mobile phones, tablets, music players and gaming devices. In the present decade, there has been a steep increase in the mobile phones market of various models and even at cheaper rates. The influence of this created a wave of increased mobile phone users and nowadays we can find hardly any person without the mobile phone. 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 rise². 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 technology³. 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 devices⁴. 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 keys⁵. Evidences also 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 device⁶. 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 symptoms⁷. 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^{8,9}. 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.

METHODS

A retrospective study was done, that included fifty nine subjects. The age group of the participants was between 5 to 56 years. All the subjects reporting pain in their upper extremities following extensive usage of hand held devices like mobile phones, tablets, iPods, etc. included for the study. They 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.

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.

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	<ul style="list-style-type: none"> • Pain relief • Restoration of flexibility 	<ul style="list-style-type: none"> • Ergonomic modification • Hand function re-training 	<ul style="list-style-type: none"> • Postural retraining • Strengthening 	<ul style="list-style-type: none"> • Improve ADL • Maintenance of function

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. The study was approved by the Institutional Review Board and the participant consent of the subjects was also obtained.

RESULTS

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 PHONE	USERS	PERCENTAGE
Blackberry	21	35.59
Other Smart phones	29	49.15
Ordinary	6	10.16
Gaming device	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 Fig 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.

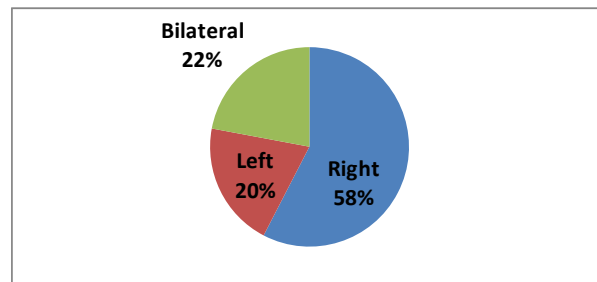


Fig 1: Affected Side of the body

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 of neck and upper back (70.37%) and thoracic outlet syndrome (51.85%). The co-morbidities are presented in Table 3.

Table 3: Associated Co-morbidities

TYPE OF DISORDER	USERS	PERCENTAGE
Myofascial pain syndrome of Neck and Upper back	19	70.37
Thoracic outlet syndrome	14	51.85
Fibromyalgia syndrome	7	25.93
Hypothyroidism	2	7.41
Wrist tendinitis	4	14.81
De Quervain's	2	7.41

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 ($p < 0.01$).

DISCUSSION

The results of our study clearly indicated the presence of musculoskeletal disorders of the upper extremity following the usage of hand-held devices. This is in accordance with studies reported in the literature. 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 thumb¹⁰. 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^{5, 11}. 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 muscles⁴. 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 literature⁹.

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 movements⁵. 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 generalization 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 various types of hand-held devices, various brands and 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.

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

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