

Muscular skeletal disorders associated with Micro Workstations

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Approval

The Design Research Project called "Musculoskeletal disorders associated with Micro workstations" by Edu Mohan (Product Design 2012-2014) is approved, in partial fulfilment of requirements of the Masters of Design degree in Product Design in Industrial Design Centre of Indian Institute of Technology, Bombay.

Prof. G G Ray
Project Guide

Declaration

I declare that this written submission represents my ideas in my own words and where others' ideas or words have been included, I have adequately cited and referenced the original sources. I also declare that I have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea/ data/ fact/ source in my submission. I understand that any violation of the above will be cause for disciplinary action by the Institute and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been taken when needed.

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Date

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Anyone I missed out

The library. The internet.

Edu Mohan
February 3rd , 2014

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Abstract

Telecommunication has taken a major leap since radio was invented and the first radio signals were transmitted in the 1901. Ever since man has been trying to reduce size of the telecommunication devices and it has come to an era where every common man can afford a mobile telecommunication device. These devices also incorporated various other value additions like music players and cameras. This emerging trend has been serving man a great advantage as he can have everything he wants in his pocket.

The shrinkage in dimensions has given an adverse effect to the humans because the human dimensions doesn't change according to the new device coming in market. Hence the mismatch causes various musculoskeletal health issues along with other issues.

This project aims to study and document a few of such musculoskeletal disorders caused by mobile telecommunication devices.

1. Micro workstations

Phones, tablets and other hand held devices like music players have been popular recently. These devices can be together categorized into micro workstations. The term “micro” is used because of the size of these devices as compared to the normal workstations like desktops and laptops.

2. History and Evolution of Telecommunication and other Handheld Devices.

Communication means connecting to someone or something and exchanging information. Communication can range from very subtle processes of exchange, to full conversations and mass communication.

Telecommunication is the science and practice of communicating by transmitting information by electromagnetic means. In earlier times, telecommunications involved the use of visual signals, such as beacons, smoke signals, semaphore telegraphs, signal flags, and optical heliographs, or audio messages such as coded drumbeats, lung-blown horns, and loud whistles.

The history of telecommunication begins with the time when people used to send smoke signals and play drums to communicate with each other in Africa, the Americas and parts of Asia.

In modern times, telecommunications includes the usage of electronic devices such as the telegraph, telephone, and teleprinter, and also the use of radio and microwave communication devices, fibre optics and their associated electronics. It further evolved with the use of orbiting satellites and the Internet.

Telecommunications began with the successful innovation of Samuel Morse's telegraph system in 1844. Western Union, the first telecommunications monopoly, was formed as a regional alliance of several smaller firms in 1856 and rapidly expanded, often following railway lines. Just a year later the six largest telegraph companies developed a cartel, dividing up the country and business among themselves. Telegraph systems initially served only land routes, as it was presumed impossible to lay lines underwater.

Availability of global telegraphy rapidly changed the face of business and government affairs. The ability to "instantly" communicate had great positive impact on business and other human aspects of daily life. The electric telephone was invented in the 1870s, based on earlier work with harmonic (multi-signal) telegraph. By 1904 there were over three million phones in the US, still connected by manual switchboard exchanges.

Paced by wartime needs and spending, Bell Labs and other researchers produced coaxial cable and microwave links that were first used commercially in the years after the war. Microwave links were less expensive than traditional telecommunication networks. Later with the advancement of technology mobile phones and World Wide Web has changed the face of modern communication mediums and connected the entire world.

The revolution in the area of telecommunication began in the 1900s with major developments in wireless communication by Nikola Tesla and Guglielmo Marconi. Marconi developed, demonstrated and marketed the first successful long-distance wireless telegraph and in 1901 broadcast the first transatlantic radio signal.

Other highly notable pioneering inventors and developers in the field of electrical and electronic telecommunications include Charles Wheatstone and Samuel Morse (telegraph), Alexander Graham Bell (telephone), Edwin Armstrong, and Lee de Forest (radio), as well as John Logie Baird and Philo Farnsworth (television).

Since then, human beings are inventing new and better ways to make communication easier. The message earlier conveyed using Morse codes, smokes, symbols and sounds has today become though peer to peer telephone calls, text messages, e-mails and multimedia messages. (History Of Telecommunication osp magazine, n.d.) (History Of Telecommunication wikipedia, 2014) (<http://www.history.com/topics/inventions/guglielmo-marconi>, 2014)



3. Aim

From big computing devices to small mobile devices the future is heading towards shrinking the size of the machines to make it more mobile and usable, most of the times while designing those devices the human factors are being ignored which is affecting the users' well-being and health. The overall aim of this research project is to document the prevalent muscular skeletal disorder due to regular use of mobile phones, tablets and other hand-held micro workstations.

STANDBY TIME

Available in the colour: Grey, Brown and Grey/Brown.

7 Character red LED display.



MOTOROLA DYNATAC 8000X
1983

Cost \$3,995 in 1983.

World's first commercially available mobile phone.

Nicknamed the "Zax Martin phone" after featuring in "Saved By The Bell".

Features include an address book and currency calculator.

8 Character red LED display.



MOTOROLA MICROTAC 9800X
1989

Multipiece actually located in base of phone.

First "flip phone" clamshell design.

Pop-out antenna for aesthetics only.



NOKIA 2110
1993

First use of corner sensitive buttons.

Vision screen feature was added with optional vibrating battery.



NOKIA 5110
1998

Day of the first mainstream consumer mobile phones.

First release of Snake game in consumer mobile phone.

First phone with replicable keypad.



NOKIA 3310
2000

OS: Million sold. 35 Million more than all Nokia sales from 1991 - 1998.

Influential in the growth of the third-party accessories market.



MOTOROLA RAZR V3
2004

Over 100 million sold.

Thinnest ever phone at time of release at 11mm thick.



APPLE IPHONE
2007

Sold over 700,000 in first weekend.

Sold more in 2 days than Motorola RAZR did in first month.

4. EVOLUTION OF THE MOBILE PHONE

Mobile phones originated from permanent vehicle mounted radio systems, as battery technology had not yet been refined to a portable enough size. A prototype of Motorola's DynaTAC was used to make the first phone call whilst walking the streets of New York in 1973, although it took another ten years for a commercial handheld device to be released. From then on mobile phones continued to decrease in size and weight and gain in technological features. Towards the end of the twentieth century, mobile phones changed from being

luxury devices to a mainstream commodity - becoming the most rapidly adopted technology in human history. Now we are tethered to the rest of the world through this small device in our pockets and another person is only a few button presses away. For better or worse - the evolution of the mobile phone has changed the way we live our lives forever.

5. Information and communication technology

The development of the information and communication technology (ICT) the last twenty years has meant a change of life style in work/school, at home and in leisure time for many of us. The access and exposure to different kinds of information and communication technologies such as computers, mobile phones and media players has continued to increase over the last decade

Indians use smartphones extensively, some of them to the point of obsession. People check their phones up to 150 times a day for various purposes. According to a research by Nokia this year, an average person checks the phone every six-and-a-half minutes in a 16-hour waking cycle.

The number of persons (aged 16-74) who use computers every day has continued to increase, in just the past two years, computer use has increased from 79 % in 2006 to 87 % in 2008. As for the rate at which the device is being adopted, there are 51 million smartphone users in urban India today, 89% higher than 27 million in 2012, according to Nielsen Informat Mobile Insights. Silicon Valley venture capital firm KPCB put the number of Indians with smartphones even higher at 67 million in June 2013. This is set to rise even further as the devices become cheaper. (<http://timesofindia.indiatimes.com/tech/computing/Smart-phone-addiction-can-give-you-text-neck-BlackBerry-thumb/articleshow/24195288.cms>, 2014)

6. Psychological Health

Information and communication technology may have an impact on psychological health although causal mechanisms are unclear. In an explorative prospective cohort study of young adult Information and communication technology users was found that for women high combined use of computer and mobile phones was associated with increased risk of reporting prolonged stress and symptoms of depression. For men, the number of mobile phone calls and SMS messages per day were associated with sleep disturbances and SMS use was associated with symptoms of depression. (Gustafsson, 2009)

7. Adverse effects of Information and Communication Technology

Information and communication technology is offering new ways of communicating and there is a concern that this widespread use of Information and communication technology could potentially have an adverse upon impact upon individual and social processes in everyday life. Today we have little knowledge of how this use of different kinds of Information and communication technology influences the users' behavior, psychological well-being and health. Considering the widespread use of Information and communication technology is of importance to identify the factors and conditions, related to this use, which influence our health.

8. Musculoskeletal symptoms/ disorder

With the advancement of technology the modes of communication has also evolved in many ways. Mobile phones are long range, portable and wireless electronic device of communication, replace the earlier most commonly used forms like post, telegraph, telephone etc. There is no doubt that these micro devices have made the life more easy, fast and comfortable. Everyone is in touch with their near and dear ones and also with the outside world.

They proved to be a big help as life savers in emergencies. Besides, they are being increasingly used as light terminals to access the internet. The more recent addition of GPS is really a tremendous help to the user as well as to the detective agencies in various situations. The cell phone or mobile phone is such a standard part of everybody's life today that one cannot imagine what life was like before it was invented. The typical mobile subscriber of today sends and receives more text messages than telephone calls, according to a recent trend report published by the Nielsen Company.

The posture people are in while texting and e-mailing from mobile devices are using thumbs to type, crunched over a tiny keyboard. It creates problems when we do it constantly without giving our body enough breaks. The term "Blackberry thumb" has been used by the media and medical professionals to describe this phenomenon. This typically creates pain at the base or in the muscles of the thumb or wrist. The thumbs are not made to do such repetitive tasks in such a small area.

As mentioned above, there are much more problems associated with usage of micro workstations such as mobile phones and touch screens.

An exposure to a combination of physical and psychosocial risk factors seems to increase the risk for developing musculoskeletal symptoms compared to only physical factors or only psychosocial factors. (AmandaHarper, 2009)

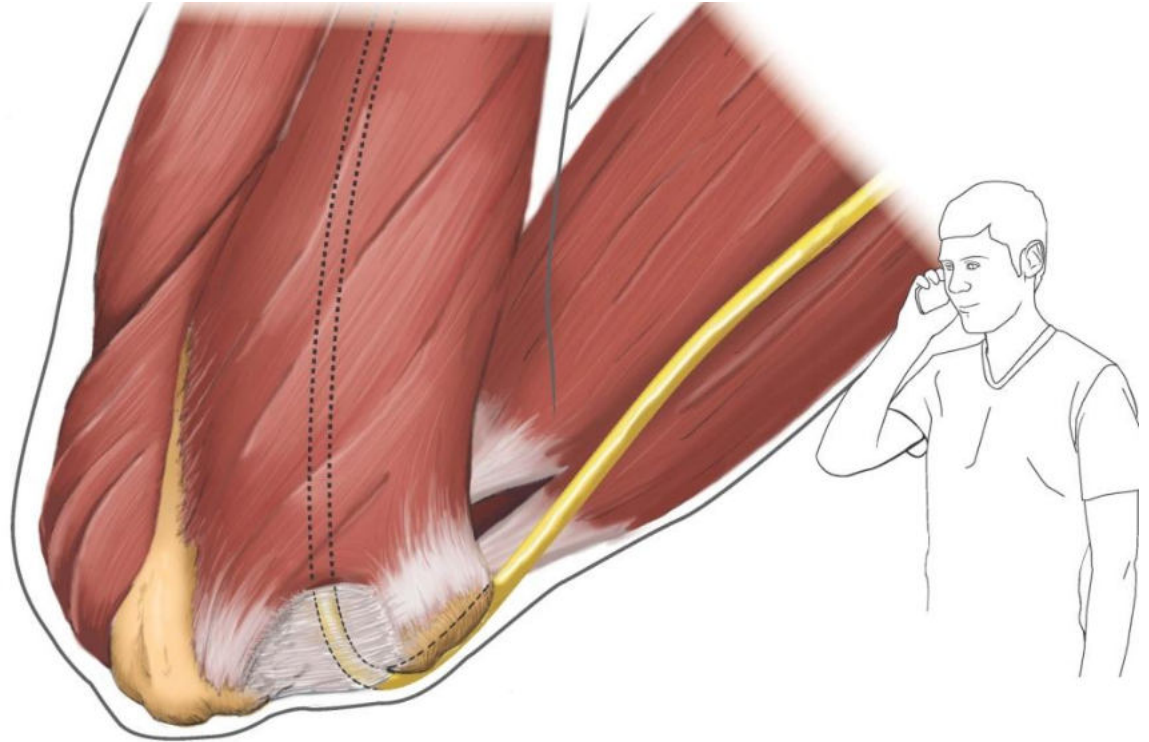
9. Cell Phone Elbow

With prolonged cellular telephone use, people may note the onset of aching, burning, numbness, or tingling in the ulnar forearm and hand. This constellation of symptoms, termed “cell phone elbow” by the lay press, is known medically as cubital tunnel syndrome—the second most common nerve compression syndrome in the upper extremities after carpal tunnel syndrome.

In most cases, treatment consists simply of modifying the activity and avoiding activities that aggravate the symptoms. Switching hands frequently while talking on the phone or using a hands-free headset can help. Other daily activities that produce cubital tunnel syndrome include leaning on an elbow while driving or working, and sitting at a computer workstation that requires elbow flexion greater than 90 degrees. Making ergonomic adjustments to these activities is beneficial.

For patients who have nocturnal symptoms, a simple elbow pad worn anteriorly or a towel wrapped around the elbow to prevent flexion while sleeping can be very efficacious. Occasionally, anti-inflammatory injections can be given to quiet an inflamed ulnar nerve and reduce symptoms. Surgical interventions are available for patients with severe, persistent symptoms. (One minute consultation, 2009)

10. Cubital tunnel syndrome



The main cause of cubital tunnel syndrome is compression of the ulnar nerve as it traverses the posterior elbow, wrapping around the medial condyle of the humerus. When people hold their elbow flexed for a prolonged period, such as when speaking on the phone or sleeping at night, the ulnar nerve is placed in tension; the nerve itself can elongate 4.5 to 8 mm with elbow flexion.

Additionally, flexion of the elbow narrows the space available for the nerve and can cause a sevenfold to 20-fold increase in the pressure within the cubital tunnel, depending on muscle contraction. This can be compounded by compression on the nerve, either from various fascial bands surrounding the nerve or from extrinsic sources of compression, such as leaning on one's elbow while driving or talking

. This increased pressure on the nerve leads to decreased blood flow and nerve ischemia; this in turn causes increased permeability of the epineurial vessels and nerve edema, enlarging the nerve and continuing the cycle.

Less frequently, cubital tunnel symptoms can be caused by the ulnar nerve subluxing in and out of its groove in the posterior elbow, leading to nerve inflammation and swelling from the repetitive friction.

Changing how one uses a cell phone often helps, as does avoiding activities that require the elbow to remain flexed more than 90 degrees for extended periods. But when non operative means fail to reduce symptoms, surgery may be warranted.

Operative interventions include simple decompression or transposing the nerve from its usual course around the posterior elbow to a path anterior to the elbow, thus decreasing the tension on the nerve. This can be done either subcutaneously or by embedding the nerve in or under the muscles of the forearm.

(<http://getbetterhealth.com/author/ramonabatesmd/page/26>, 2014)

11. Blackberry thumb

BlackBerry thumb is a form of repetitive strain injury (RSI) caused by the regular use of the thumbs to press buttons on PDAs, smartphones, or other mobile hand held devices. The name of the condition comes from the BlackBerry, a brand of smartphone, although there are numerous other similar eponymous conditions that exist such as "Wiiitis", "Nintendinitis", "Playstation thumb", "cellphone thumb", "smartphone thumb", "Android thumb", and "iPhone thumb". The medical name for the condition is De Quervain syndrome and is associated with the tendons connected to the thumb through the wrist. Causes for the condition extend beyond smartphones and gaming consoles to include activities like golf, racket sports, and lifting.

Symptoms of BlackBerry thumb include aching and terrible pain in the thumb and wrist. In severe cases, it can lead to temporary disability of the affected hand, particularly the ability to grip objects.

The believed reason to the disorder is that the thumb does not have the dexterity the other four fingers have and is therefore not equipped enough for fast speed touch typing. (http://en.wikipedia.org/wiki/BlackBerry_thumb, 2014)



http://i.telegraph.co.uk/multimedia/archive/01856/blackberry_1856771c.jpg

12. Conclusion

Hand-held electronics can require prolonged gripping, repetitive motion of the thumb and fingers while using small buttons and awkward wrist movements. Users tend to sit slumped, with their neck protruded and look down at small screens. Posture is one of the root causes of musculoskeletal disorder, and it is next to impossible to maintain good posture when using these gadgets. These devices are also getting smaller with even more features but the human anthropometry doesn't change with the change in size of these devices.

Hand-held devices that promote the predominant usage of thumb are associated with a higher prevalence of musculoskeletal disorder. This will pave way for designers to appropriate design of hand-held devices and improving user friendliness according to the anthropometry of the users.

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