Pilot-scale investigation of the impact of the use of an alternative posture computer mouse upon median nerve conduction in Carpal Tunnel Syndrome negative and positive determined subjects.

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Background:

The computer mouse was invented in 1968 as an input device to facilitate the use of the graphical user interfaces that emerged and have now replaced the text input DOS operating systems. Since then the graphical user interface has become the primary mechanism of user/software interaction, which has created an extensive dependency upon the use of the computer mouse for software manipulation; the Internet environment is especially mouse usage intensive. For some time there has existed a non descript medical correlation between the extent of computer use and non-specific syndromes, often referred to as Repetitive Strain Injuries (RSI) and Carpal Tunnel Syndrome (CTS). Most of the evidential data gathered has been based upon statistical reporting of clinical presentation and no direct clinical investigations are known of that look at the impact of the mousing posture relative to a clinical marker in a random sample of subjects.

Introduction:

Alternative cause and consequence scenarios have been postulated as to the precipitating agent of computer work related syndromes. One opinion is that “Repetition”, such as the number of finger actuations performed when, for example, typing, is a likely protagonist. Consideration has now been given to the possible impact of mousing posture, by way of the outcome of maintaining a twisted wrist while and when applying constant, though low force, grip upon the computer mouse. In ergonomic terms this is called a “Static Posture”. This has resulted in an alternative design of computer mouse, which is the subject of this study that the manufacturer claims both untwists the wrist and removes the need to maintain a constant grip.

This study was commissioned by the manufacturer, (Designer Appliances, Inc., Mineola, NY, US) to determine if, if any, a clinically significant effect could be observed by the use of their alternatively designed mouse (Model: AirO_2bic mouse) that prescribes a wrist untwisted and grip-less posture, when measured by such a posture’s impact upon the distal latency of the median nerve in subjects who routinely use a computer mouse for six to eight hours a day. The AirO_2bic (study) mouse is described by its manufacturer as permitting the user to

work in what is known as a Functional Neutral posture in which those muscles that are ordinarily employed for mousing, forward of the elbow, are seldom used, if used at all.

Objective:

Current non-surgical solutions for managing and treating Carpal Tunnel Syndrome include setting up “ergonomically correct” [on the basis of current ergonomic risk perception] computer workstations. This often entails the use of arm or wrist supports, attention to monitor positioning, keyboards and mouse designs that are to a currently perceived “more correct” standard and also specially designed furniture. The purpose of this investigation is to establish if the use of the study mouse can have a measurable impact on median motor and/or sensory nerve distal latencies in a random small sample of subjects that are not known to have any prior history of Carpal Tunnel Syndrome. A null hypothesis [no postural impact detected] is assumed, which would mean that no measurable effect would be observed upon median sensorimotor latencies of the subjects over the three month test period.

Methodology:

The study consisted of subjects who work on computers and use a mouse for six to eight hours per day. Median motor and sensory distal latencies were tested and the subjects then used the study mouse as their sole mouse device during the next three months. Motor and sensory distal latencies were measured initially and on a monthly basis thereafter using a Neuromax 1000 EMG machine (XLTEK, Oakville, Ontario, Canada). Temperature was monitored with a thermistor throughout the analysis.

Prior history was obtained from each subject and subjects were excluded if any entrapment neuropathies or neurological disease with distal latency involvement were identified. All testing was conducted at Brevard Rehabilitation Medicine Electrodiagnostic Lab (Melbourne, Florida, US) and those subjects enrolled were advised of their analysis results and their consent to participation in the study was obtained.

Subjects had their conventional “palm down” mice replaced with the study mouse and continued to perform the same work under the same workload as before.

Motor Distal Latency is a measurement of the time taken for an electrical stimulus, created by the test equipment, to reach an electrode placed on the thumb. Nerve impingement, such as may occur with the Median Nerve where it passes through the carpal tunnel, can lengthen the time it takes for such a stimulus to take affect.
Sensory Distal Latency is a “reverse firing” of the nerve to determine the latency of the sensory nerve system, which again are extended in time when impingement occurs.

A value of 4 milliseconds (marked upon the graphs attached as the diagnostic threshold) is considered the clinically significant value for a diagnosis of Carpal Tunnel Syndrome.

Results:

Five of the initial twelve subjects tested met the diagnostic criteria for CTS with motor and or sensory distal latencies greater than 4.0 milliseconds (see tables below). The remaining subject's distal latencies were within the normal range.

Several subjects were lost to the study due to various non impacting reasons with the result that seven subjects, of the original twelve enrolled, remained and are fully reported under the 3-month study criteria.

Monthly interval testing of the subjects with prolonged distal latencies demonstrated a consistent trend of improvement in their distal latencies (sensory>motor) most measured falling back below the diagnostic threshold.

Those subjects with normal distal latencies remained in the normal range and their latency values improved away from the diagnostic threshold.

There appeared to be no significant changes in temperature.

Tabulated Data:

Motor Distal Latency:

Month	0	1	2	3
Subject #8	3.4	3.4	3.3	DC
6	3.8	3.8	3.7	3.3
4	3.3	3.4	3.6	3.2
3	3.8	3.8	3.9	3.9
5	3.8	3.7	3.7	3.6
1	4.2	4.0	4.1	4.0
7	4.5	4.5	4.4	4.3
2	4.4	3.9	DC	DC

Sensory Distal Latency:

Month	0	1	2	3
Subject #8	3.5	3.3	3.4	DC
6	3.5	3.6	3.6	3.2
4	3.6	3.8	3.2	3.1
3	4.0	3.8	3.9	3.8

5	4.1	3.9	3.8	3.6
1	4.1	3.9	3.7	3.6
7	4.3	4.2	4.1	4.0
2	4.4	3.9	DC	DC

Discussion:

It is interesting to note that the study revealed that almost half the subjects had undiagnosed Carpal Tunnel Syndrome at the onset of the study. In regards to the Functional Neutral posture prescribed by the study mouse: the outcomes are as follows: -

Null Hypothesis Theory:

This has been shown to be invalid as there is a clinically measurable impact by changing from the “palm down”, so static muscular and wrist twisted mousing posture, compared to the Functional Neutral, wrist untwisted and grip-less posture prescribed by the study mouse. While the study size is limited, so the statistical establishment of the degree improvement not ascertainable, simple data inspection shows that after 3-months 13 of the 14 latencies measured at the end of the study were lower (so improved) relative to the start. The one outlier was still within the normal range. Of the 5 Carpal Tunnel Syndrome diagnosable subjects found at the start of the study only one subject remained above the diagnostic threshold at the end and that subject had noticeably improved towards the diagnostic threshold level.

Sensory Distal Latency:

Was measured as being diagnostic for CTS in 3 of 7 subjects at the start and zero of 7 subjects at the end of the study.

Motor Distal Latency:

Was measured as being diagnostic for CTS in 2 of 7 subjects at the start and 1 (referred to as the “outlier” above) of 7 subjects at the end of the study.

Conclusion:

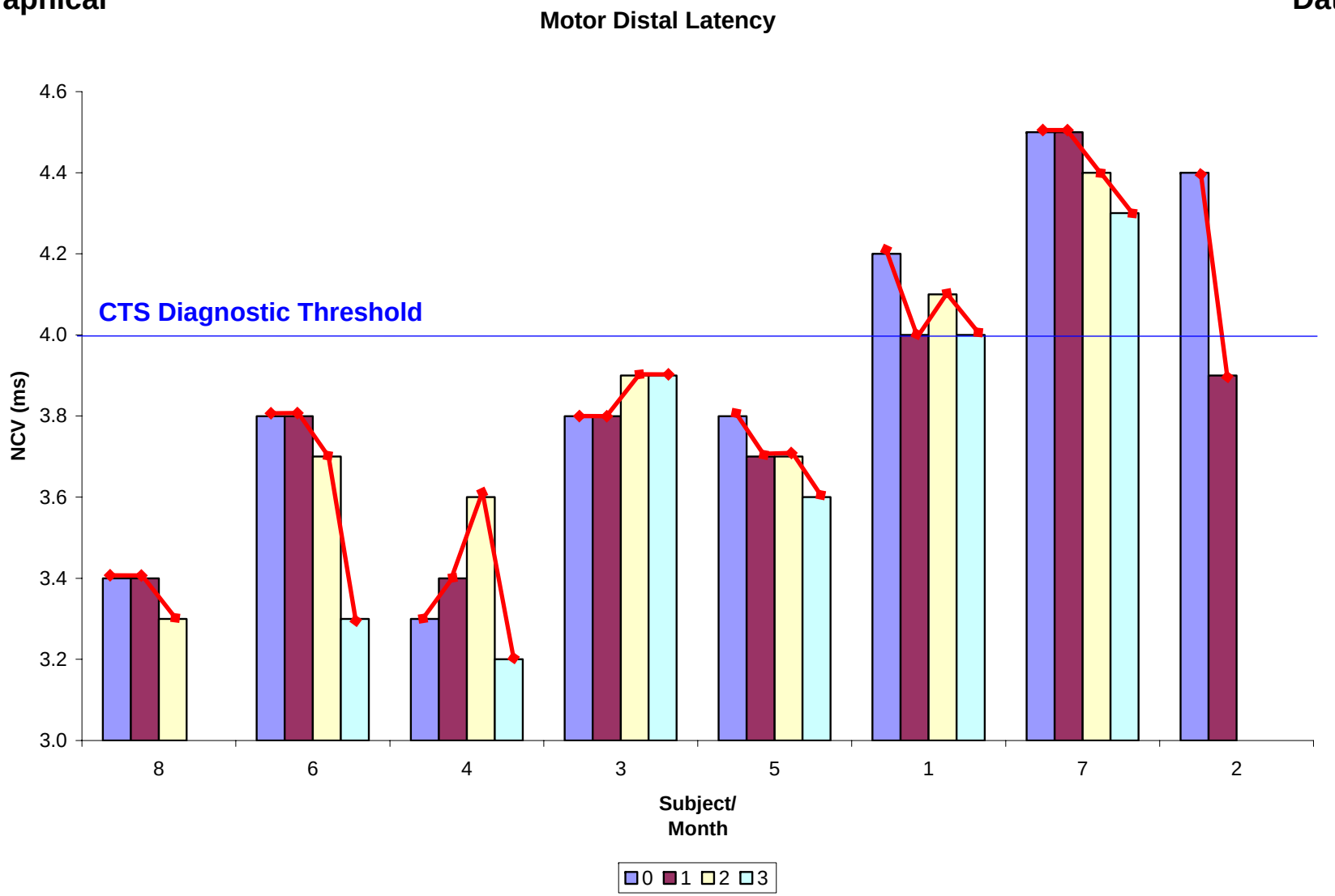
The Functional Neutral posture prescribed by the study mouse has made a measurable positive impact on the latencies measured in the subject group. Due to the small sample size and the relative position of the subjects at the start of the study the statistical significance as to the degree of the impact cannot be gauged, but the “empirical conclusions” of a positive impact are valid and support the premise that mousing posture and therefore mouse design are a factor of significance in the symptomatic determination of Carpal Tunnel Syndrome by nerve conduction testing.

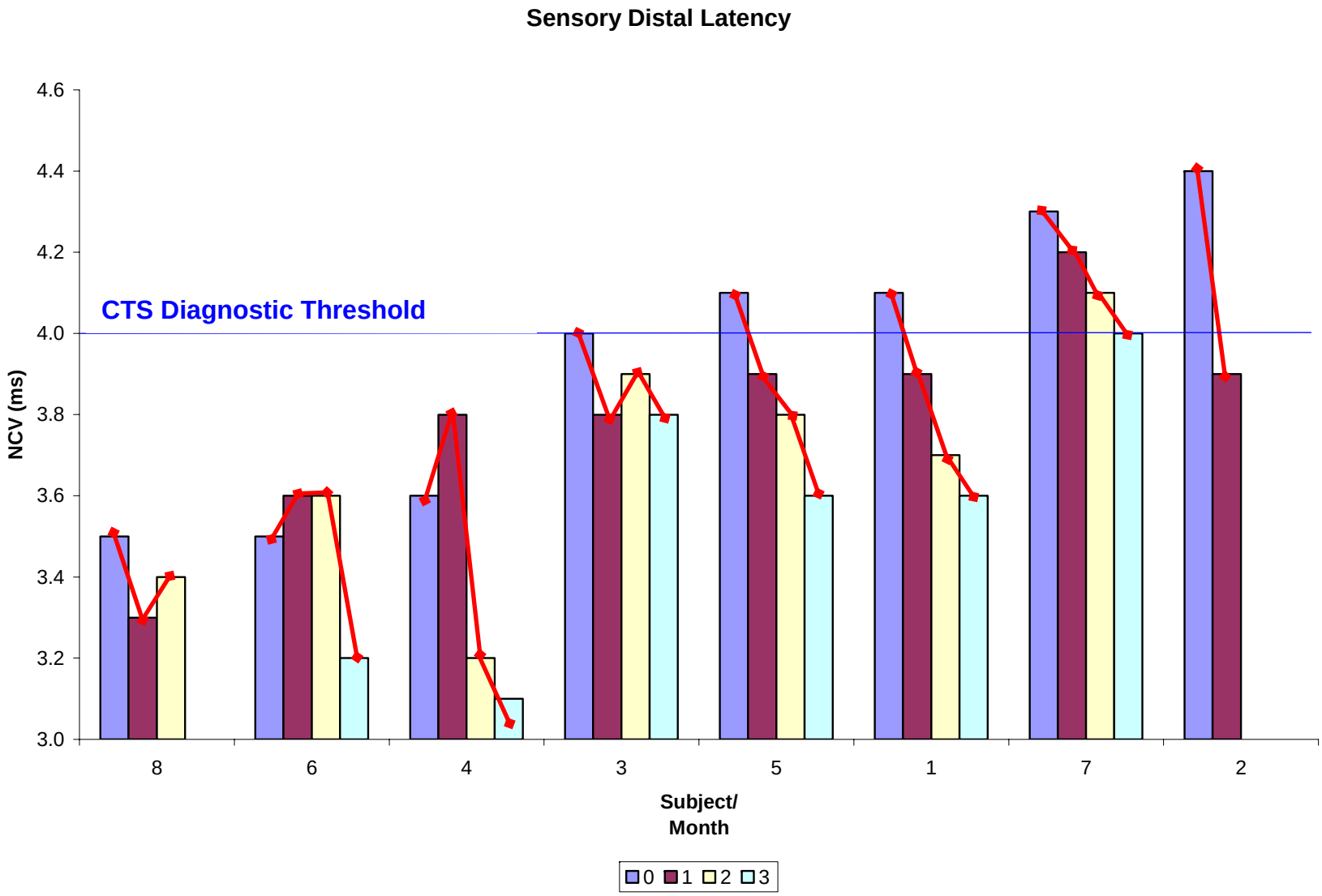
The use of the study mouse did not appear to cause the subjects any other complications, detected or reported.

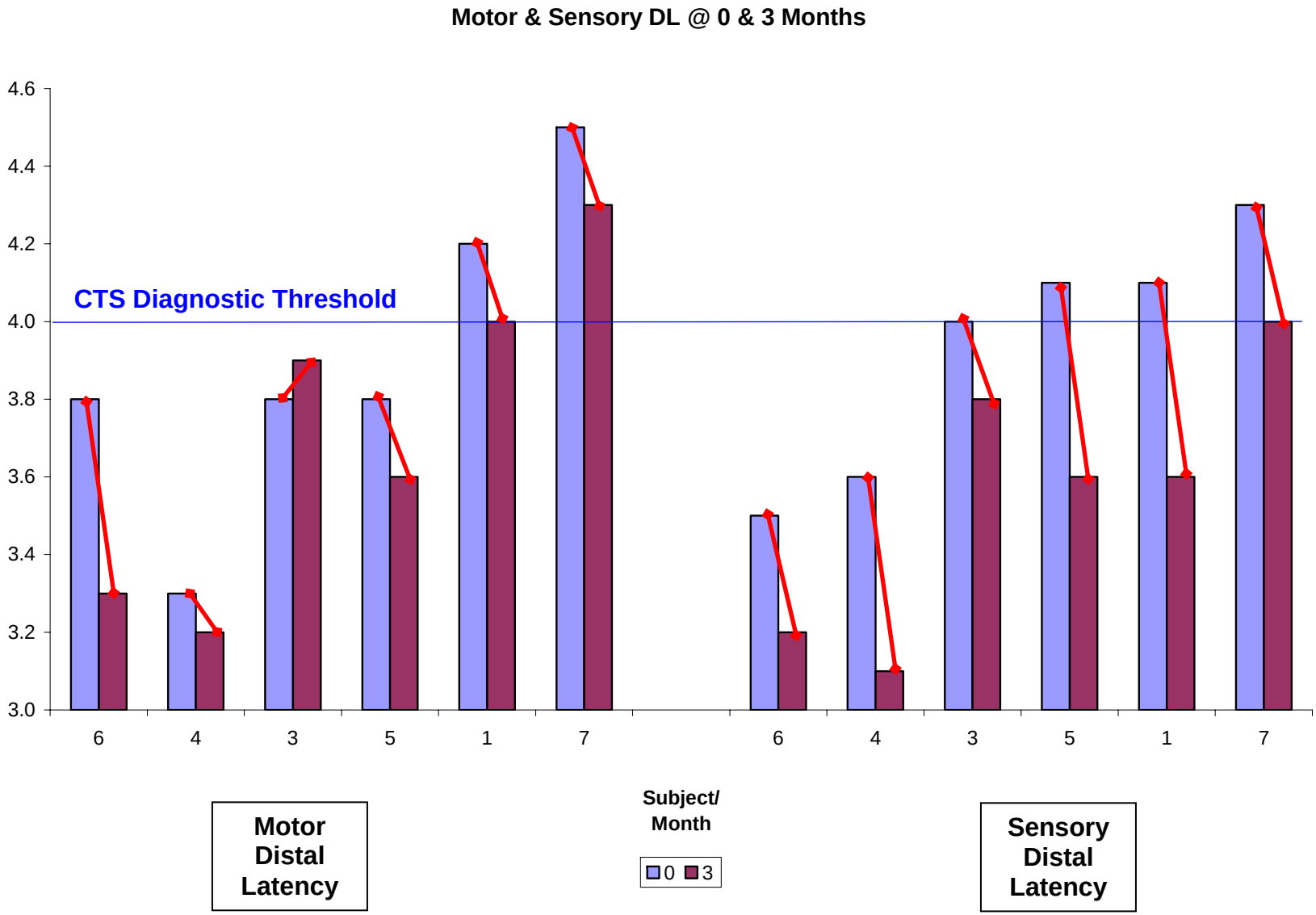
On the basis of the results gained a further large scale study is considered justified as this study demonstrates that nerve conduction testing is a clinically valid marker for the determination of mousing posture and mouse design. We know of no such study being performed or reported upon in the past. A future study protocol would be to a design that determined more operator variables though, as stated, this study was intentionally limited to the establishment of evidence for a correlation between the analysis technique and mousing posture.

Additionally, in a further study, the use of ultrasound analysis alongside of nerve conduction studies could provide further clinical correlation as to the benefits of the use of the study mouse and the mousing posture it prescribes, beyond those determined in this study alone.

Graphical **Data:**




Sensory Distal Latency
CTS Diagnostic Threshold
NCV (ms)
4.6
4.4
4.2
4.0
3.8
3.6
3.4
3.2
3.0
8
6
4
3
5
1
7
2
Subject/
Month
0
1
2
3


Motor & Sensory DL @ 0 & 3 Months
4.6
4.4
4.2
4.0
3.8
3.6
3.4
3.2
3.0
CTS Diagnostic Threshold
6
4
3
5
1
7
6
4
3
5
1
7
Subject/
Month
0
3
Motor
Distal
Latency
Sensory
Distal
Latency