BIOMECHANICAL TESTING AND STUDY OF INDUSTRIAL WORKERS WEARING A PROTECTIVE VIBRATION DEVICE: TENEX ELBOW SHOCK ABSORBER.

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DISCLAIMER: Dr**.** Mann and Kinesis Research Ltd. were hired on a strict fee-for-services basis by Vancouver Projects International Inc., to report on the effectiveness of the Tenex ESA device in the treatment of Lateral and Medial Epicondylitis.
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Abstract
There is some evidence in the literature that a significant number of industrial workers employing heavy vibration producing tools will show symptoms of lateral epicondylitis at some time during their working careers. The causes behind their predisposition for this injury are unclear although the literature to date has focused on age and physical conditions as a contributing factor. It is here hypothesized that vibrations is a critical component in the occurrence of the symptoms of lateral epicondylitis. This study examines the effectiveness of a device named Tenex Elbow Shock Absorber (ESA) on industrial workers who suffer from symptoms related to lateral and medial epicondylitis. For the purpose of this study we will be referring to both conditions (lateral and medial) as lateral epicondylitis.

Tenex ESA: Description
The Tenex Elbow Shock Absorber (ESA) is produced by Vancouver Projects International Inc. It is a specifically designed semi-spherical container of high impact polycarbonate, ultrasonically sealed, ultraviolet resistant, and filled with a liquid metal (99% HG) weighing 50 grams.
This device, when worn on the wrist, is purported to reduce vibrations to the wrist and elbow to reduce or eliminate symptoms of lateral and medial epicondylitis.

Background.
Reynolds and Angevine looked at vibration transmission to the hand and arm[1] . Their results suggest that vibration at frequency above 100 Hz directed into the hand remains isolated in the hand. Therefore, if the impact vibration is above 100 Hz very little of this vibration may be transmitted to the elbow[1.]

E. Goel and Rim showed that vibrations transferred through the hand from a pneumatic chipping hammer were reduced by 45.5% when wearing sorbothane gloves.

Comparison were made across a broad range of frequencies, suggesting that a device capable of absorbing energy over a broad range of frequencies may be of benefit [2].

Lateral epicondylitis and related disorders have been cited throughout the literature as major causes of lost time and workers' compensation claims in industrial plants [3,4]. Lateral epicondylitis develops as an inflammatory cycle that is seen in three major stages:

A- Acute inflammatory stage.
B- The chronic fibroblastic stage.
C- The re-injury stage [5].

Correlation have been demonstrated between this type of injury and the type of repetitive motion of the upper extremity [3.4], the force created through the use of tools [3,4,6,8,9,10] and the body position maintain by employees while working [3,4.6.8].

Testing Effectiveness of Tenex ESA

In this study, it is hypothesized that an increase in strength and endurance combined with a decrease in pain registered by the subjects using Tenex ESA, would indicate that the device has a positive effect on the subject's condition. This is supported by numerous studies which demonstrate that not only pain inhibits strength and endurance but also show that pain subsides as a sign of recovery and healing of the injury [7,8,9,12]

The first part of the study will measure peak acceleration of vibrations on 60 subjects using industrial tooling while wearing the Tenex ESA device. The second part will study these subjects for a period of 90 days to determine the effectiveness of the Tenex ESA device.

In both instances results will be compared to data from a group wearing a placebo and a computer analysis of all data will produce average charts for all results.

Methodology

50 men and 10 women were chosen to participate in this study. All subjects match the following profile:

Age:	Between 30 and 40 years old.
Employment:	5 years minimum.
Professional Activities:	75% include the use of a hammer (i.e. carpenter's)
Health:	Non-smokers with no family history of high blood pressure.
Leisure:	No activities conducive to arm injury.
Particulars:	Right handed.
Symptoms:	Chronic symptoms of Lateral epicondylitis for a minimum of 3 years.
Last medical diagnosis:	In the last 5 months.
Treatment:	Never had surgery - No treatment given at least 30 days prior to study.

Randomly, 30 subjects were given Tenex ESA to wear, while 30 subjects were given a placebo of the same size and weight as Tenex ESA. The Tenex ESA used in all trials weighed 38.3 grams.

The placebos, when empty, weighed 13,7 grams. and were filled with a lead weight to increase the weight to 50 grams.

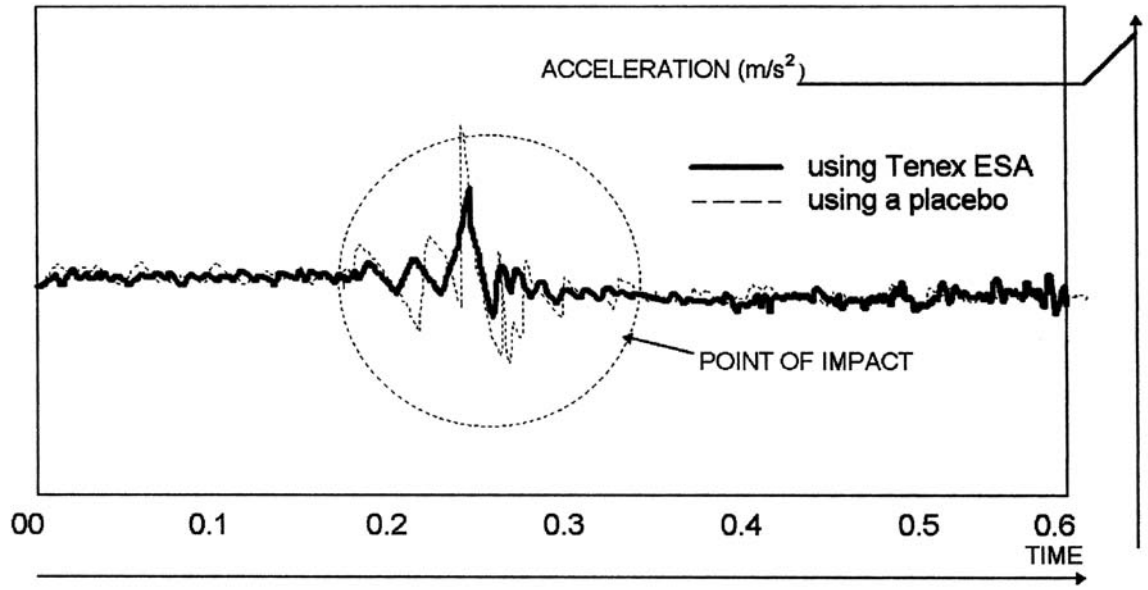
Part 1: Testing the device.

A laboratory study was performed to obtain graphs of the vibrations on the elbow to highlight the variability in peak acceleration at the elbow and draw comparative statistical analyses of the results.

This study involved testing each subject and measuring peak accelerations of vibrations while using a hammer-drill on a cement wall for 20 minutes to determine if Tenex ESA has an effect on the vibration level affecting the elbow.

For each subject, a piezotron accelerometer (Kistler 8616A500) and piezotron coupler (Kistler 5112) was attached by tape to the elbow (lateral and medial epicondyle of humerus) of the arm showing the symptoms of trauma. The signal is amplified 100 times with a I Khz low pass filter and a 10 Khz high pass filter. The high pass filters out the majority of the low frequency arm movements, highlighting the impact accelerations. The amplified signal is recorded (Teca TE4 Electrornyograph). Vertical deflections of 1 cm represent 59 m/s^2

CHART I : Comparative statistical analyses chart of 60 tests performed



Results: There was a significant difference of the peak accelerations of the impact between the subjects wearing TENEX ESA and these wearing a placebo. A damping effect of 50% was registered, regardless of the sex of the subjects.

Part 2: Testing strength, endurance and pain

Using the same methodology as in the previous test, each subject of each group was first tested for:

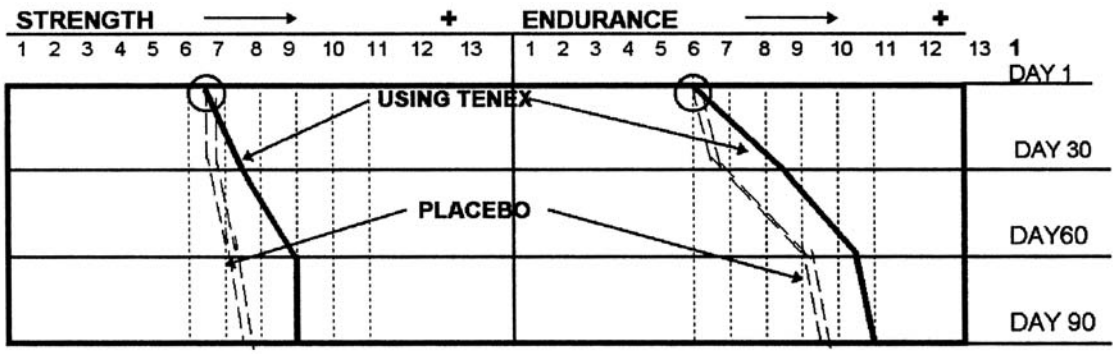
a) strength b) endurance c) pain. (day 1)

b) All subjects wore the device for 90 days, and were re-assessed during this period every 30 days through an identical test of strength, endurance and pain.

1-Strength and endurance.

A Cybex II isokinetic system and a Takei grip dynamometer were used to quantify strength and endurance. Each subjects was tested 20 times on each machine while a laboratory assistant registered results. All data were input into a computer for a final statistical analysis and for the production of a single chart averaging all results from the test group and the group wearing a placebo.

CHART 2: Comparative statistical analyses chart of 60 tests performed



Results: The data show a significant improvement in the condition of strength and endurance in most subjects wearing the Tenex device over the group wearing the placebo regardless of the sex of the subjects.

After each "strength and endurance test" (see Chart 2 above), each subject completed the following questionnaire (on Days 1, 30, 60 and 90). This self assessment follows a multiple choice format which permits grading of the intensity and of the frequency of pain experienced by each subject. All data were entered into a computer for a final statistical analysis and for the production of a single chart averaging all results from both the test group and the group wearing a placebo.

Questions:

-DURING TESTING DID YOUR ELBOW DISCOMFORT INCREASE As THE LENGTH OF THE SESSION INCREASED?
NEVER - NOT OFTEN - ON OCCASION - NO CHANGE – OFTEN – USUALLY - ALWAYS

-HOW WOULD YOU ASSESS YOU CURRENT DEGREE OF DISCOMFORT DURING TESTING?
NO PAIN – MINOR - SOMEWHAT PAINFUL – BEARABLE - QUITE PAINFUL – HIGH - ACUTE

-HOW WOULD YOU ASSESS YOU CURRENT FREQUENCY OF DISCOMFORT DURING TESTING?
NEVER – SELDOM – OCCASIONLY – 50% OF THE TIME – OFTEN – USUALLY - ALWAYS

CHART 3: Comparative statistical analysis of Subjects' self-assessment of pain.

DURING TESTING DID YOUR ELBOW DISCOMFORT INCREASE AS THE LENGTH OF THE SESSION INCREASED?

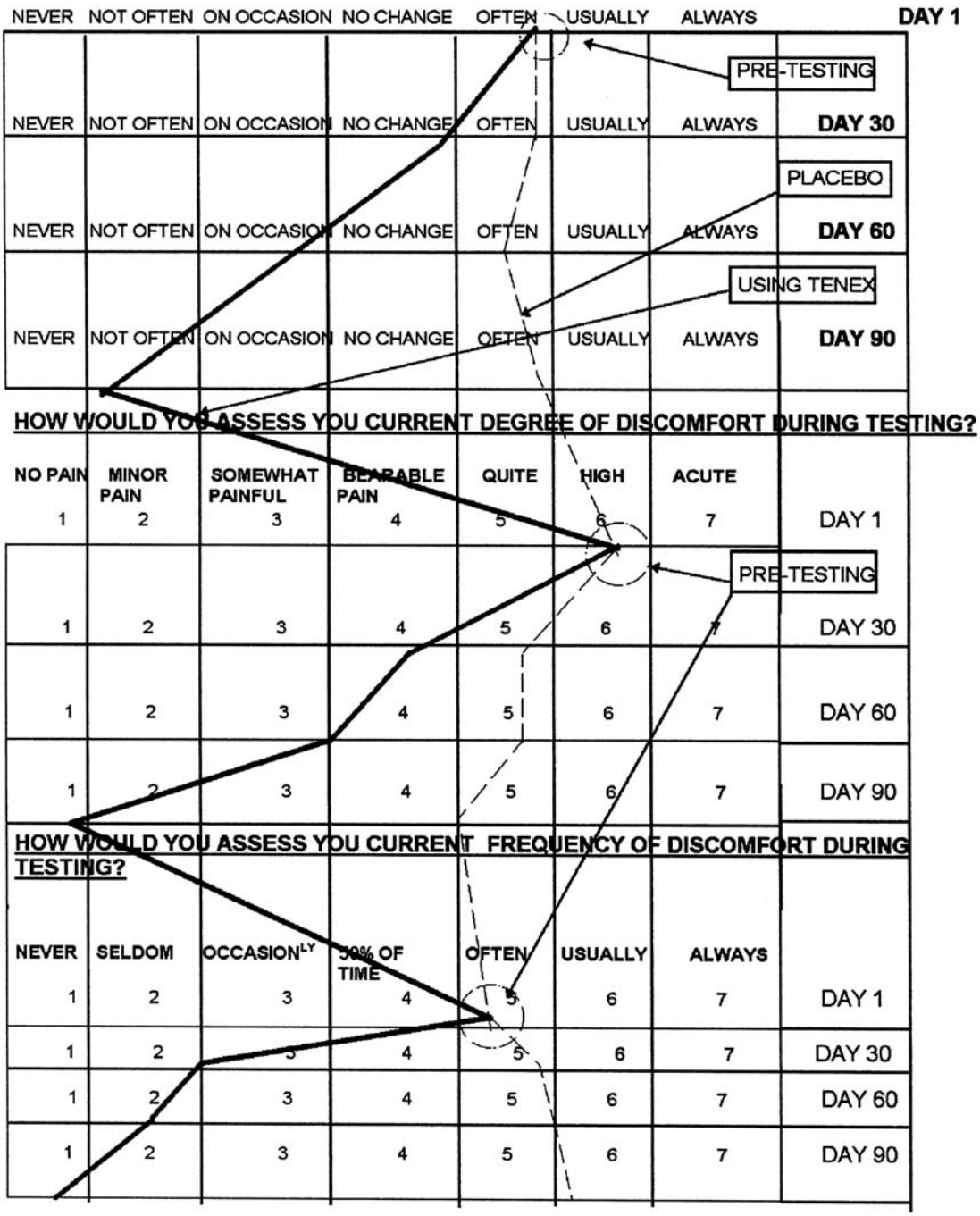


CHART 3: in all three questions related to pain the group wearing Tenex ESA showed a marked improvement over the group wearing a placebo, regardless of the sex of the subjects.

Conclusion:

The group using a placebo showed a slight overall increase in strength and endurance and an improvement in the level of pain experienced, although to a much lesser degree than the test group. This may be attributed to either a placebo effect or to some damping effect of the lead dummy weight used to replace the oil and ball bearings in the Tenex capsule.

The results obtained in all 3 tests are consistent with previous studies on the effectiveness of Tenex as a shock absorber[11] .

In this study we witnessed that the Tenex ESA device dampens vibrations by 50% over a placebo resulting in an improvement in strength and endurance from the subjects tested, as well as a significant reduction of the intensity of pain experienced by the subjects.

We conclude that the Tenex Elbow Shock Absorber is very effective in the reduction of symptoms of Lateral and Medial Epicondylitis conditions.

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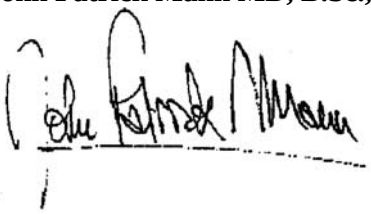

Notes:

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