UNIVERSITI PUTRA MALAYSIA

CONCEPTUAL DESIGN, DEVELOPMENT AND FABRICATION OF A PROTOTYPE ERGONOMIC LUMBAR SUPPORT FOR MOTORCYCLISTS

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CONCEPTUAL DESIGN, DEVELOPMENT AND FABRICATION OF A PROTOTYPE ERGONOMIC LUMBAR SUPPORT FOR MOTORCYCLISTS

By

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Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfilment of the Requirements for the Degree of Doctor of Philosophy

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CONCEPTUAL DESIGN, DEVELOPMENT AND FABRICATION OF A
PROTOTYPE ERGONOMIC LUMBAR SUPPORT FOR MOTORCYCLISTS

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This study was conducted with the intention to investigate the need, design, develop,
fabricate and testing a prototype of an ergonomic lumbar support for motorcyclists. The
development process began with identifying the importance and the problems of existing
motorcycles in the market. Motorcycle is the second common modes of transportation in
Malaysia. As a relatively cheap and reliable mode of transportation, it is widely used by
a large cross section of peoples. However, the current motorcycle design does not
accommodate a back posture support and motorcyclists are more exposed to
musculoskeletal disorders (such as low back pain). This study was undertaken in 5
stages (methods) in order to achieve its objective; survey on motorcyclists discomfort,
anthropometric data collection, design, develop and fabricate the prototype using Pugh’s
Total Design Process Model, Testing 1 (using Borg’s Scale) and Testing 2 (using
Electromyography (EMG)) . The whole study was conducted in Polytechnic Sultan
Azlan Shah, Perak, using the students (motorcyclists) as the sample. Their age ranges 18
to 24 years old. The results (survey) indicate that, majority (>50%) of the motorcyclists
experienced discomfort in their body parts during the riding process. Higher discomfort
rate was reported on the motorcyclist’s upper body parts (neck or head, shoulder, upper
back, arms and hands, low back and buttocks) and correlated with their the riding
posture. The critical design dimensions for the prototype (height, width, adjustable range
and thickness) were obtained from the anthropometric dimensions of motorcyclists and
were used in the design process. The subjective method results highlight that the rate of discomfort level (in all body parts) decreased over time during the testing period with the prototype (lumbar support). In terms of the discomfort ‘break point’, the motorcyclists identified low back and upper back as the most affected body parts prior to comfort changes during the testing period with the use of the prototype. Meanwhile, the electromyography results show a reduction of muscle activity in the lumbar region in term of the average EMG values, maximal voluntary contraction (%MVC) of EMG activities at the 10th, 50th and 90th percentile and EMG change over time (mean % change per measurement period). Overall, the use of prototype provides a protective mechanism (provides postural stability and integrity) for the motorcyclist’s musculoskeletal system, particularly the spinal column (from exposures to intensity, duration and frequency of physical risk factors which contribute to the low back pain). Therefore, this prototype is capable of providing ideal posture while simultaneously enhancing the comfortability (reduce discomfort) of the motorcyclist during the riding process. However, further evaluation on the prototype needs to be conducted to determine their stability, solidity, durability and safety over prolonged use.
Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Doktor Falsafah

REKABENTUK KONSEPTUAL, PEMBANGUNAN DAN FABRIKASI SATU PROTOTAIP ERGONOMIK BAGI PENYANDAR POSTUR LUMBAR UNTUK PENUNGGANG MOTOSIKAL

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APPROVAL

I certify that an Examination Committee met on 1.12.2011 to conduct the final examination of Karmegam Karuppiah on his Doctor of Philosophy thesis entitled “Conceptual design, development and fabrication of a prototype ergonomic lumbar support for motorcyclists” in accordance with Universiti Pertanian Malaysia (Higher Degree) Act 1980 and Universiti Pertanian Malaysia (Higher Degree) Regulations 1981. The Committee recommends that the candidate be awarded the Doctor of Philosophy.

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DECLARATION

I declare that the thesis is my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously, and is not concurrently, submitted for any other degree at Universiti Putra Malaysia or other institution.

KARMEGAM KARUPPIAH

Date: 1 December 2011
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