CLINICAL IMPROVEMENTS FOR SPINAL CORD INJURED SUBJECTS GOING THROUGH INNOVATIVE REHABILITATION TECHNIQUES AND PARALYMPIC SPORTS
FNS AUGMENTATION OF RECIPROCATING HKAFO AND KAFO BRACES
Bioengineering Unit, University of Strathclyde, Glasgow, UK.
DRLAU, Robert Jones & Agnes Hunt Orthopaedic Hospital, Oswestry UK.

INTRODUCTION
Two orthotic approaches exist that aim to assist locomotion in the spinal cord injured subject. The traditional orthotic approach that utilises passive external mechanical bracing to facilitate standing and reciprocal walking by means of upper limb mediated posture shifting and gravitational actions; the second approach utilises active movements induced by means of functional neuromuscular stimulation (FNS). FNS synthesised walking is more aesthetic than locked knee gait using KAFO’s and may require less upper limb effort. However, maintaining upright support of body weight can present a limitation in the presently used schemes. For example, a continuous activation of quadriceps to stabilise
Editorial

É com grande satisfação que apresentamos à classe médica a primeira edição da Revista Ortopedia e Traumatologia Ilustrada.

Trata-se de uma feliz parceria entre a Atha Comunicação e Editora e os Departamentos de Ortopedia e Traumatologia da Faculdade de Medicina de Ribeirão Preto-USP e Unicamp. Assumimos a tarefa de sermos os editores deste novo veículo de comunicação e divulgação das técnicas cirúrgicas utilizadas na Ortopedia e Traumatologia para a comunidade médica do Brasil.

Sob o patrocínio do Atha, esta publicação visa através de uma leitura prazerosa contribuir com a atualização e avanços científicos, além de oferecer várias informações úteis no cotidiano dos nossos leitores por meio de artigos ricamente ilustrados.

A publicação está aberta a todos que queiram enviar seus artigos.

Esperamos contribuir com a divulgação e abrir um novo canal de comunicação com os colegas.

Alberto Ciclitira Junior
Helton L. A. De Fino
COMPREHENSIVE NEUROLOGIC REHABILITATION
Volume 3

Neuromuscular Stimulation: Basic Concepts and Clinical Implications

Paraplegic Locomotion and Its Metabolic Energy Expenditure

A. Cliquet, Jr., *R. H. Baxendale, and B. J. Andrews

Bioengineering Unit, University of Strathclyde, and *Institute of Physiology, University of Glasgow, Glasgow, Scotland.
Theme of this presentation is twofold:

Engineering Sciences on Innovation Technology for Rehabilitation of SCI Patients.

Medical Sciences towards Functional Diagnoses, Therapy, and Cardiovascular Health with Sports Performance.
Post-training

TA R

GA R

SO R

40µv

80µv

80µv

Stance  Swing
A

Angle

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\text{Setup Graph}
\]

B

Angle

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\text{Angle} \quad \text{L ankle dorsif} \quad 21.50
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5 Hz

0.7 Hz

\[
\text{3ms/div}
\]

\[
\text{3ms/div}
\]

1

2

3

4

\[
\text{Typical Graphs showing gait cycle angles}
\]

\[
\text{Cursor marks indicate specific points in the gait cycle}
\]

\[
\text{Graphs compare 5 Hz and 0.7 Hz conditions}
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<th>HORÁRIO</th>
<th>LOCAL</th>
<th>TEMA</th>
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<td>Princípios de Reabilitação do Ap. Locomotor e Biomecânica Ortopédica</td>
<td>A,B,C</td>
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<td>Fraturas I: princípios gerais de diagnóstico e tratamento</td>
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<td>Prof. William</td>
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| Qui  | 08:00-10:30 | Imobilização na Emergência | A,B,C | T/P | Prof. Miranda/ Michael |
|      | 10:30-12:00 | Discussão de casos junto ao Programa de Residência Médica | A,B,C | T   |
| Sex  | 08:00-09:30 | Punho e mão: revisão da anatomia topográfica e semiologia. Lesões abertas e síndromes compressivas | A,B,C | T   | Prof. Ulson |
|      | 09:30-12:00 | Atividade Prática 2 no Amb. Ortopedia | A,B   |     |        |
|      |            | Atendimento no Pronto Socorro | C     |     |        |
General health is fundamental to SCI individual.

Osteoporosis and cardiovascular disease have been under study.

Loss of bone mass is known to be higher in tetraplegics than paraplegics, and the same applies to carotid intima-media thickness of SCI subjects which is larger in tetraplegics.

SCI physiotherapy focuses mostly on cardiovascular exercises and, of course, do not apply the mechanical loads to the lower limbs required to maintain bone quality.
CHOQUE DE CIÊNCIA

Sem a ajuda de exoesqueleto
Laboratório do Hospital das Clínicas da Unicamp usa impulsos elétricos para fazer com que paraplégicos voltem a andar - trabalho único no Hemisfério Sul

Rafael Kato - Info - 06/2014
• Neuromuscular electrical stimulation (NMES)

• Increase the venous return, stroke volume, cardiac output

• Mechanical load:
  - Weight-bearing activities
  - Muscle contraction
GG: 75% presented a significant increase of bone formation markers; 66.67% also presented a significant decrease of bone resorption markers.

CG: 30% of individuals did not present any change of bone markers and only 20% of individuals presented an increase of bone formation markers.
• Quadriplegics
  - Extensive muscle paralysis
  - Sympathetic autonomic impairment

Decrease of bone mass

Decrease of physical deconditioning
Knowledge of exercise physiology is essential for implementing strategies to develop optimal physical performance among individuals with spinal cord injury, due to Somatic/Sympathetic Nervous System Dysfunction.
CARDIORESPIRATORY RESPONSES TO ELECTRICALLY STIMULATED PARALYSED QUADRICEPS MUSCLES

<table>
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<tr>
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<th>Pa (mmHg)</th>
<th>pO₂ (KPa)</th>
<th>pCO₂ (KPa)</th>
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<tr>
<td>Rest</td>
<td>134x84</td>
<td>12,56±0,38</td>
<td>4,87±0,17</td>
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<td>NMES</td>
<td>171x84</td>
<td>13,34±0,43</td>
<td>4,79±0,19</td>
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<tr>
<td>Recovery</td>
<td>138x89</td>
<td>13,79±0,24</td>
<td>4,40±0,18</td>
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</table>
Gait group:
Control group:
Physical activity is associated with improved subclinical atherosclerosis in spinal cord injury subjects independent of variation in traditional risk factors.


Physical activity and improved diastolic function in spinal cord-injured subjects.


CONCLUSION: Regular physical activity is associated with improved LV diastolic function in SCI subjects and might exert distinct cardiac structural effects in tetraplegic and paraplegic subjects.
CERTIFICADO

Prof. Dr. Alberto Cliquet Junior

foi vencedor da categoria Saúde e Esporte no VIII Prêmio SAÚDE, pelo trabalho
A prática regular de esporte está associada à atenuação de alterações vasculares
e cardíacas em indivíduos com lesão crônica da medula espinhal, realizado na
Universidade Estadual de Campinas.

São Paulo, 28 de novembro de 2013

Fábio C. Barbosa
Presidente Executivo
Abril S.A.

Lucia Helena da Oliveira
Diretora de Redação
Revista SAÚDE
CONCLUSIONS: The small number of patients in this study did not allow us to confirm the hypothesis that X-ray finding may indicate risk for shoulder pain in spinal cord injury patients. A work with a greater number of subjects could demonstrate association between shoulder pain and the reduced acromioclavicular distance, making plain radiography a trial exam for spinal cord-injured patients.
Is sport practice a risk factor for shoulder injuries in tetraplegic individuals?

<table>
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<td></td>
<td>Atletas (%)</td>
<td>Sedentários (%)</td>
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<tr>
<td>AGU</td>
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<td>15</td>
</tr>
<tr>
<td>AAC</td>
<td>60</td>
<td>90</td>
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<tr>
<td>Tendinopatia SE</td>
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<td>90</td>
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<td>Ruptura SE</td>
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<td>25</td>
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<tr>
<td>Tendinopatia IE</td>
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<td>25</td>
</tr>
<tr>
<td>Tendinopatia SUB</td>
<td>5</td>
<td>30</td>
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<tr>
<td>CLB</td>
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<td>40</td>
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<tr>
<td>Bursa</td>
<td>55</td>
<td>60</td>
</tr>
<tr>
<td>Atrofia muscular</td>
<td>5</td>
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AGU: articulação glenoumeral; AAC: articulação acromioclavicular; SE: supraespinál; IE: infraespinál; SUB: subescapular; CLB: cabo longo do biceps; IC: intervalo de confiança; * p<0.05, diferença estatisticamente significante.

CONCLUSION: Tetraplegic athletes and sedentary individuals have a high incidence of supraspinatus tendinosis, bursitis and ACJ degeneration. Statistical analysis showed that there is a possible protective effect of sport in the development of shoulder injuries. Weak evidence was encountered for infraspinatus and subscapularis tendinopathy and muscle atrophy (P=0.09, P=0.08 and P=0.08, respectively). Strong evidence with P=0.04 suggests that sedentary tetraplegic individuals are at a greater risk for ACJ and labrum injuries.
Impact of Wheelchair Rugby on Body Composition of Subjects With Tetraplegia: A Pilot Study.


CONCLUSIONS: Regular WR training increased lean mass and bone mineral content in the arms and decreased total body fat mass. Conversely, WR training was associated with decreased bone mineral content in the trunk. These results suggest that regular WR training improves body composition in subjects with tetraplegia.
RESULTS: Of the total hips, only seven (23%) had no evidence of articular damage. The prevalence of heterotopic ossification found (16.6%) was similar to the literature.
BIODEVICES 2011
International Conference on
Biomedical Electronics and Devices

26 – 29 January, 2011
Rome, Italy

Conference Details
› Technical Program
› Call for Papers
› Program Committee
› Invited Speakers
› Keynote Speakers
› Satellite Events
› Workshops

BIODEVICES is part of BIORTEC, the International Joint Conference on Biomedical Engineering Systems and Technologies
Registration to BIODEVICES allows free access to all other BIORTEC conferences

The purpose of the International Conference on Biomedical Electronics and Devices is to bring together researchers and practitioners from electronics and mechanical engineering, interested in studying and using models, equipments and materials inspired from biological systems and/or addressing biological requirements. Monitoring devices, instrumentation sensors and systems, biorobotics, micro- nanotechnologies and biomaterials are some of the technologies addressed at this conference.

PROGRAM CHAIR
Pedro Vieira, Universidade Nova de Lisboa, Portugal

KEYNOTE SPEAKERS
› Alberto Cliquet Jr., State University of Campinas, Brazil
› Mário Forjaz Secca, Universidade Nova de Lisboa, Portugal
› Tanja Schultz, Karlsruhe Institute of Technology, Germany
› Bradley Nelson, ETH Zurich, Switzerland

20.09.2013
Kammermusiksaal

FES WORKSHOP (Functional Electrical Stimulation and Neuroprosthetics)
FES Gait
09:00 - 10:30; Chairs: Manfred Bijak, Karen Minassian
9:00 - 9:30 Invited lecture: Experiencing FES roots on education, clinical developments in paraplegia and tetraplegia with technological innovation
Alberto Cliquet Junior
2 Tetraplegics
Lesion level C4A (C5)
Dear Prof. Cliquet,
I was asked by the congress committee to organise a symposium at the 2010 ISPO world congress [http://www.ispo-2010-leipzig.de](http://www.ispo-2010-leipzig.de) The title of the symposium is "Innovative Technologies for Powered Upper Limb Orthoses".
I know that you are working on a hybrid system for upper limb movement restoration in quadriplegics very successfully!
Kind regards,
Christian Pylatiuk

Karlsruher Institut für Technologie (KIT)
Spasticity assessment - Pendulum test, before training with NMES and after training with NMES
System for Assessment of Spasticity in the Upper Limbs

Renato Varoto, Andrea A. P. Cabezas, Ana Paula S. Barbosa, Alberto Cliquet Jr.

**Introduction**
Spasticity is one of the most common, potentially disabling and troublesome complications that affect individuals with spinal cord injury. In particular, quadriplegics may have spasms and joint stiffness in the upper limbs. Currently, this condition is qualitatively assessed through clinical scales; electrophysiological methods are also used. Thus, a proper assessment assists in determining the most effective therapy.

**Objectives**
Assessment of spasticity in the upper limbs using equipment and method developed. This evaluation is based on the quantification of spasms and joint angle of the wrist, and seeks to minimize the subjective aspect of the other methods.

**Practical application and target audience**
- Assessment of spasticity in the upper limbs of quadriplegics.
- Characterization of spasms in the upper limbs.
- Medical device companies.
- Hospitals and medical clinics.

**Developmental stage**

```
Basic research → Laboratorial scale production → Prototype → Pilot plant
```

Area: Machines and Equipment, Health and Care

Protected patent number: BR 10 2014 028514 8

Universidade de São Paulo

EESC

LABCIBER

LABORATÓRIO DE BIOMECÂNICA E REABILITAÇÃO DO APARELHO LOCOMOTOR
P group:

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Four subjects detected pain due to heat and heat pain tolerance, with three subjects (all AIS A) presenting muscular spasms at 55°C.
Escola de Engenharia de São Carlos

Engenharia Elétrica

Disciplina: SEL0395 - Introdução à Engenharia de Reabilitação
Introduction to Rehabilitation Engineering

Escola de Engenharia de São Carlos

Engenharia Elétrica

Disciplina: SEL0396 - Introdução à Instrumentação Eletrônica Biomédica
Introduction to Biomedical Electronic Instrumentation
Câmara Municipal de São Carlos
Rua 7 de Setembro, 2.878 - Centro - CEP 13560-188 - São Carlos - SP

MOÇÃO DE CONGRATULAÇÃO
Manifesta congratulação com o Professor Doutor Alberto Clquet Junior pela destacada atuação como presidente da 7ª Biodevices realizada em Angers, França.

Considerando que o docente do Departamento de Engenharia Elétrica e de Computação da Escola de Engenharia de São Carlos (EESC) da USP, Alberto Clquet Junior, destacou como Program Chair (presidente) da 7th International Conference on Biomedical Electronics and Devices (Biodevices), que ocorreu entre os dias 3 e 6 de março, em Angers, na França;

Considerando que foi o primeiro convidado ao professor doutor como Program Chair em uma conferência internacional (fato raro, pois tradicionalmente é convidado um pesquisador local), o que representa um reconhecimento aos trabalhos e apresentações anteriormente realizadas por ele em eventos internacionais;

Considerando que o Prof. Dr. Clquet Junior participou como palestrante principal na 4ª Biodevices, ocorrida em 2011, em Roma, e como palestrante convidado no 11th Vienna International Workshop on Functional Electrical Stimulation, em 2013, na cidade de Graz, na Áustria;

Considerando que, citado no Google Scholar cerca de 100 vezes ao ano, o docente – que também é professor do Departamento de Ortopedia e Traumatologia da Faculdade de Ciências Médicas e responsável pelo Laboratório de Biomecânica e Reabilitação do Aparelho Locomotor do Hospital de Clínicas, ambos da Universidade de Estadual de Campinas (Unicamp) – realiza pesquisa na área de lesão medular em pacientes paraplégicos e tetraplégicos, na qual aplica estímulo eletrotrôno neuromuscular para gerar movimentos dos membros inferiores e superiores;

Considerando que a trajetória de Clquet Junior merece o reconhecimento da coletividade são-carlense pelo alcance de sua atuação, tendo sido ele convidado já para a edição de 2015 da Biodevices a ser realizada em Lisboa, Portugal; é que:

Submeto ao Plenário esta MOÇÃO DE CONGRATULAÇÃO com o Professor-Doutor Alberto Clquet Junior pela destacada atuação como presidente da 7ª Biodevices realizada em Angers, França. Dê-se ciência da deliberação ao docente, aos membros do Departamento de Engenharia Elétrica e de Computação da Escola de Engenharia de São Carlos (EESC) da USP e do Departamento de Ortopedia e Traumatologia da Faculdade de Ciências Médicas da Universidade de Estadual de Campinas (Unicamp).

Sala das sessões, 3º de março de 2014
LINEU NAVARRO
Vereador-PT
Until recently, SCI has been taken as a neurological irreversible damage. Rehabilitation techniques, technology and sports can provide a longer life to these patients and minimize their clinical complications.

The work presented has been done entirely in the State of São Paulo, Brazil. We would like to express gratitude to: UNICAMP, USP, FAPESP, CNPq and CAPES.
Acknowledgement

The authors thank the support by grants from State of São Paulo Foundation for Research – FAPESP.
Search results

Items: 1 to 20 of 35

1. Impact of Advanced Sports Activities on the Progression of Cardiac Arrythmias in Subjects With Spinal Cord Injury
   PMID: 26168178
   Similar articles

2. Experiencing Functional Electrical Stimulation Roots on Education and Clinical Development in Paraplegics and Tetraplegics With Technological Innovation
   Varozi R, Cliquet A Jr.
   PMID: 25920161
   Similar articles

3. Impact of Wheelchair Rugby on Body Composition of Subjects With Tetraplegia: A Pilot Study
   Gorla JJ, Costa E Silva Ade A, Borges M, Tannhoff RA, Godoy FS, Caliceti DR, Sambos AOE, Ramos CD, Nadruz Junior W, Cliquet Junior A
   PMID: 26243304
   Similar articles

4. Posture influence on the Pendular Test of Spasticity in Patients with Spinal Cord Injury
   de Azevedo ER, Maria RM, Alonso KC, Cliquet A Jr.
   PMID: 26201651
   Similar articles

5. Pilot randomized controlled trial to evaluate the effect of aquatic and land physical therapy on muscular strength of sickle cell disease patients
   Zanoni CT, Galioto F, Cliquet Junior A, Szad ST.
   PMID: 25956917
   Free PMC Article
   Similar articles

6. Trunk restraint therapy: the continuous use of the harness could promote feedback dependence in poststroke patients: a randomized trial.
   PMID: 24725521
   Free PMC Article
   Similar articles

7. Is soon practice a risk factor for shoulder injuries in tetraplegic individuals?
   Medina GM, Jesus CL, Feresio DM, Folesco EM, Serabão GL, de France Urquiola F, Cliquet A.
   PMID: 24137730
   Similar articles

8. Artificial gait is complete spinal cord injured subjects: how to assess clinical performance
   Pinto KO, Abreu DC, Vasconcelos-Neto R, Martins LE, Cliquet Jr A.
   PMID: 26157257
   Free PMC Article
   Similar articles
A low-cost instrumented glove for monitoring forces during object manipulation
MC Castro, A Cliquet Jr
Rehabilitation Engineering and Assistive Technology (2007)

Evaluation of advanced computer vision techniques for non-invasive gait analysis
RL Ortolan, RN Morton
Neural Systems and Rehabilitation Engineering Conference, 2000

Metabolic and cardiovascular responses during treadmill gait on an hinged partial body weight support with a footplate
DCL Carvalho, M de la Rua, MA Moda, A Cliquet Jr
Spinal Cord 43 (7), 420-423

Effect of treadmill gait on bone markers and bone mineral density of quadriplegic subjects
DCL Carvalho, CR Garlipp, PV Bottini, SH Afaz, MA Moda, A Cliquet Jr
Brazilian journal of medical and biological research 39 (10), 1357-1363

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The purpose of the International Conference on Biomedical Electronics and Devices is to bring together researchers and practitioners from electronics and mechanical engineering, interested in studying and using models, equipments and materials inspired from biological systems and/or addressing biological requirements. Monitoring devices, instrumentation sensors and systems, biorobotics, micro-nanotechnologies and biomaterials are some of the technologies addressed at this conference.

CONFERECE CO-CHAIRS

Guy Plantier, ESEO, GSII, France
Tanja Schultz, Cognitive Systems Lab (CSL), University of Bremen, Germany
Ana Fred, Instituto de Telecomunicações / IST, Portugal
Hugo Gamboa, LIBPHYS-UNL / FCT - New University of Lisbon, Portugal

PROGRAM CHAIR

Alberto Cliquet Jr., University of São Paulo & University of Campinas, Brazil
The mission of IFESS is to promote the research, application, and understanding of electrical stimulation as it is utilized in the field of medicine through meetings, tutorials, publications, and the exchange of information.

In the last 20 years, the Laboratório de Biomecânica e Reabilitação do Aparelho Locomotor (LABRAL - UNICAMP) and the Laboratório de Biomecânica e Engenharia de Reabilitação (LABCIBER - UFSC) have been dedicated to the rehabilitation of disabled patients. At LABCIBER, technologies to assist, treat and assess patients with neurological disorders have been developed. The clinical intervention at LABRAL, in which about one hundred patients are enrolled in rehabilitation programmes that involve the application of electrical stimulation to generate movements of the upper and lower limbs. Furthermore, of particular relevance is the assessment of patients through motion analysis, cardiorespiratory evaluation, EMG, evoked potential and diagnostic imaging.

Chair: Alcides Ciclei Jr.
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International Functional Electrical Stimulation Society - IFESS
Abstract

Spinal cord injuries are responsible for enormous impact on health and well being. That, together with the financial burden to the community justifies this proposal. The CSISCI will provide immediate access of patients to our clinic (about one thousand patients/month), thus solving a chronic problem of delaying care to paraplegics and tetraplegics. Videos showing our current results are presented (http://g1.globo.com/sp/campinas-regiao/jornal-da-eptv/vid/esto-studio-da-usp-sao-carlos-ajuda-tetraplegicos-a-recuperar-parte-dos-movimentos/3287586/) and a presentation (in English) as Keynote Speaker in Rome, 2011 (http://www.bioestec.org/BIOSTECE22011/keynote_speakers.asp#Cliquet).

The Centre for Science and Innovation in Spinal Cord Injury will focus on novel procedures such as functional diagnosis on paraplegics and tetraplegics, therapies towards lessening the burden of secondary conditions (cardiovascular diseases, osteoporosis, pressure sores) and the production of new technology to be offered by biomedical companies to public and private hospitals (electrical stimulation in upper and lower limb control, Paralympics rowing, instrumentation). Children education and training of undergraduate and postgraduate in engineering and life sciences is a major aim of this proposal. Paralyzed people hardly have access to technological advances, products reaching just a small population in general, and it has become obvious from our previous work that technology can allow complete independence to those individuals, including sensory motor recovery! Knowledge and mobility breakthroughs will be disseminated to Society. Multidisciplinary and high level international integration will certainly yield state of the art devices and procedures.