

We are IntechOpen, the world's leading publisher of Open Access books Built by scientists, for scientists

6,900

Open access books available

186,000

International authors and editors

200M

Downloads

Our authors are among the

154

Countries delivered to

TOP 1%

most cited scientists

12.2%

Contributors from top 500 universities



WEB OF SCIENCE™

Selection of our books indexed in the Book Citation Index
in Web of Science™ Core Collection (BKCI)

Interested in publishing with us?
Contact book.department@intechopen.com

Numbers displayed above are based on latest data collected.
For more information visit www.intechopen.com



Electromyography Monitoring for Complete and Incomplete Transections of the Spinal Cord in Humans Who Received a Cell Therapy Combined with LASERPONCTURE® or LASERPONCTURE® Only: Methodology, Analysis, and Results

Albert Bohbot

*Laboratoire de Recherches sur le Laserponcture®
France*

1. Introduction

The most difficult thing to achieve in the case of a spinal cord injury (SCI) and/or spinal trauma is to objectively assess the progress and voluntary motor recovery. The exercise becomes even more hazardous when one sets as a preliminary rule that **each SCI or spinal trauma is unique and original both in its bone and spinal anatomical location, and in its consequences on the whole body**. Starting from here, we assume that there is no standard approach but an observation process to be adapted for each special case.

For example, two SCI individuals suffering from a complete transection of the spinal cord at anatomical level T5 will show totally different clinical pictures. They may be affected, or not, by spasticity – even flaccidity for some cases with a loss of mass muscle – or neurological pain. Each case is different and should have its own approach.

Before any examination can take place, a preliminary face-to-face interview to understand the injury and its manifestations is fundamental. Every single thing should be investigated during this interview whether it concerns the motor or sensory level, as well as the bowels and bladder functions, and sexual function. The information collected should be as thorough as possible. A psychological check-up should not be discarded either as it provides the SCI individual's input regarding his/her body image and relations s/he has with others.

Electromyography monitoring is a pioneering work published in the peer-review journal *Cell Transplantation* and presented in various scientific meetings.

Avicenna (980-1037), a Persian philosopher and physician commonly known as **Ibn Sīnā**, was credited with the following quotation “**the sick person cannot only be encompassed through his disease**”.

2. Aim

The aim of this chapter is to highlight that a voluntary muscle activity below the SCI can be measured by electromyography monitoring.

Several groups were investigated:

Group A: incomplete spinal trauma with the following subgroups:

- Laserponcture® only
- Laserponcture® combined with ensheathing stem cells
- Laserponcture® combined with ensheathing autologous stem cells
- Laserponcture® combined with autologous hematopoietic cells
- Laserponcture® combined with a therapy based on multiple autologous stem cells

Group B: complete spinal trauma (complete transection of the spinal cord) with the following subgroups:

- Laserponcture® only
- Laserponcture® combined with ensheathing stem cells
- Laserponcture® combined with ensheathing autologous stem cells
- Laserponcture® combined with autologous hematopoietic cells
- Laserponcture® combined with a therapy based on multiple autologous stem cells

The *American Spinal Injury Association Classification of Spinal Cord Injury* defines a complete or incomplete SCI in its ASIA Impairment Scale as the following:

- A = Complete: no motor or sensory function is preserved in the sacral segments S4-S5;
- B = Incomplete: sensory but not motor function is preserved below the neurological level and includes the sacral segments S4-S5;
- C = Incomplete: motor function is preserved below the neurological level, and more than half of key muscles below the neurological level have a muscle grade less than 3;
- D = Incomplete: motor function is preserved below the neurological level, and at least half of key muscles below the neurological level have a muscle grade of 3 or more;
- E = Normal: motor and sensory functions are normal.

3. Methods and material

Exclusion criteria:

- depression
- hyper spasticity

Inclusion criteria:

- complete or incomplete transection of the spinal cord treated by Laserponcture® only or Laserponcture® combined with a stem cell therapy
- cases with flaccidity post injury

Guidance and instructions for the patients were to voluntary contract the tested muscles (quadriceps, abdominal muscles, etc.) on demand. The sessions were also recorded on video.

The cases studied were selected according to the severity of the injury on MRI.

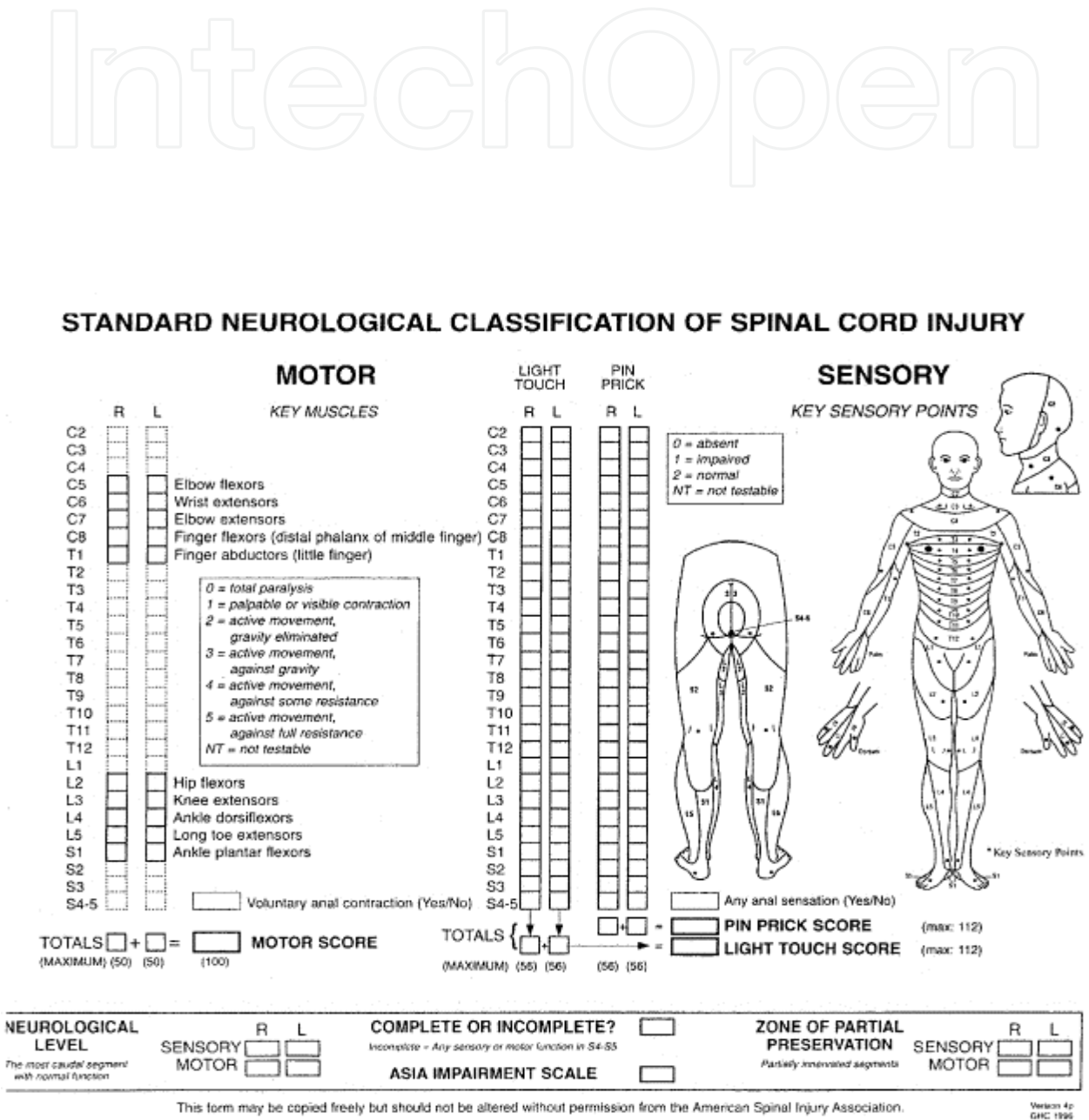
For each recording, a zeroing was performed to erase the parameters of the previous test with the aim of monitoring a change in the spasticity appearing during the examination.

Commentary

During the recordings, the following observations can be made:

- a. a low curve when the individual is at rest predicts an increased response to the voluntary act during the next test

b. spasticity sometimes appears; it suggests muscle fatigue and requires to stop the test
More than 150 cases underwent the tests.
The PROCOMP5™ equipment with softwares BIOGRAPH INFINITI 5® and REHAB SUITE™ especially adapted to SCIs; the sensors MYOSCAN-PRO™ EMG (SA9401M-50) to record muscle activity, and FLEX/PRO™-SA9309M to record skin conductance were fixed on the skin. The unit of measurement is the μ Volt.



4. Presentation of graphs and interpretation

4.1 Presentation of the graphs used

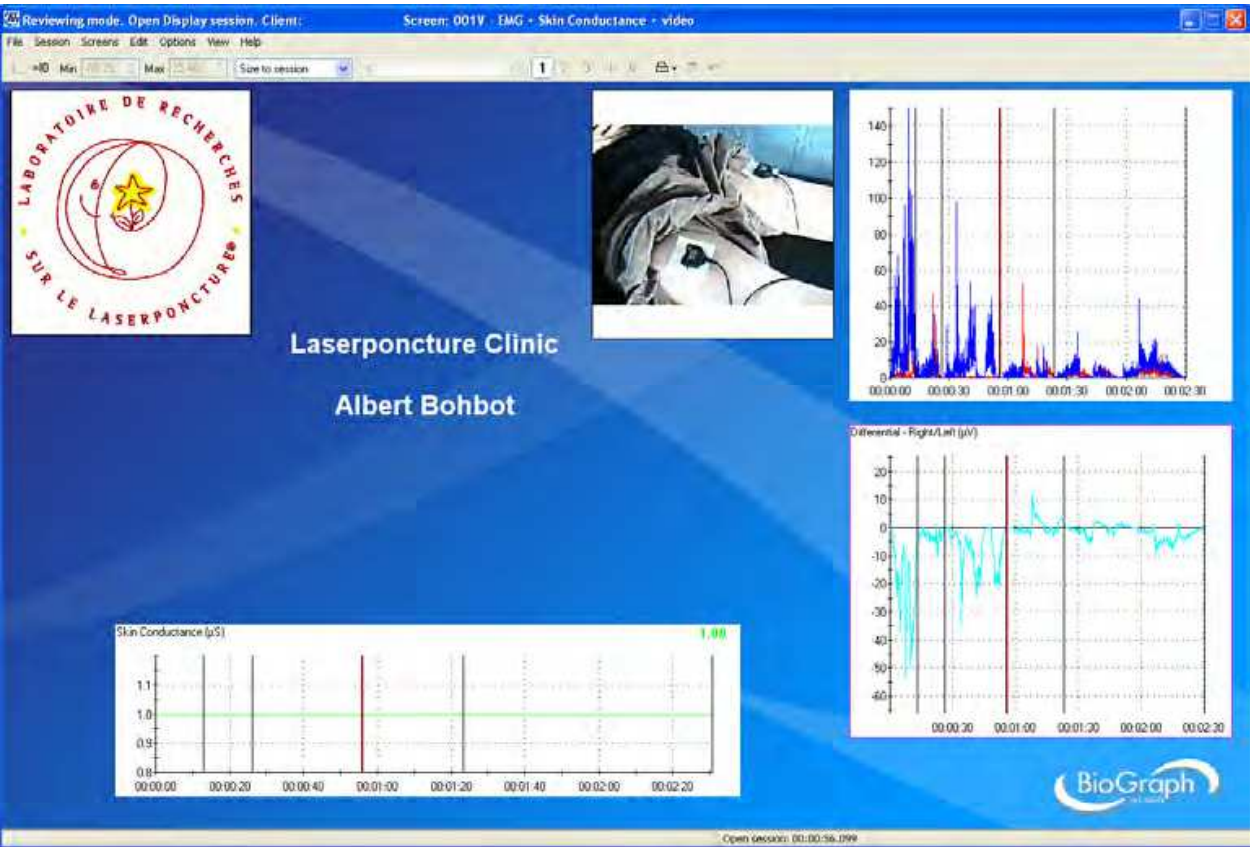


Fig. 2. Example of graphs used.

Graph A (top right): the red line represents the recorded activity of the right lower limb (RLL); the blue line represents the recorded activity of the left lower limb (LLL).

Graph B is obtained by arithmetic subtraction (bottom left): above 0: recorded activity of the RLL; below 0: recorded activity of the LLL.

4.2 Different types of activity recordings

Examples of graphs and their interpretation

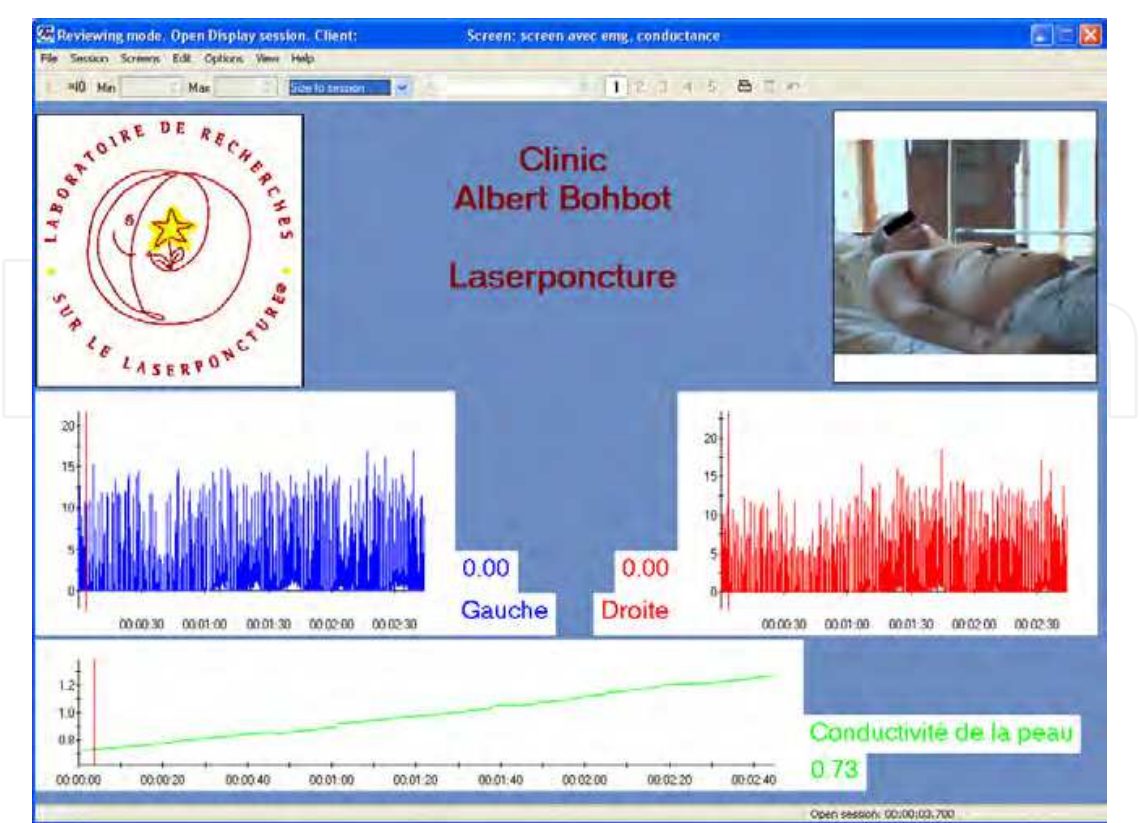


Fig. 3. Example of a muscle activity interference caused by spasticity.

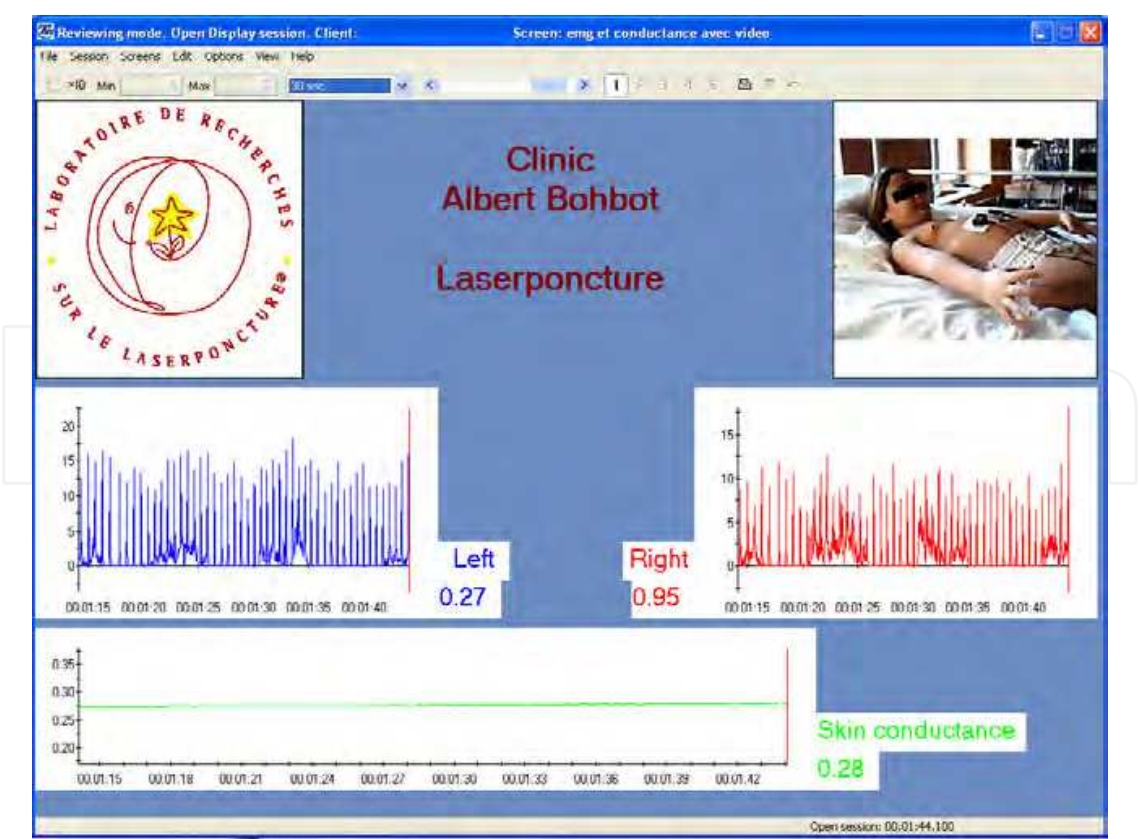


Fig. 4. Example of interference caused by the umbilical artery beatings (regular rising curve).

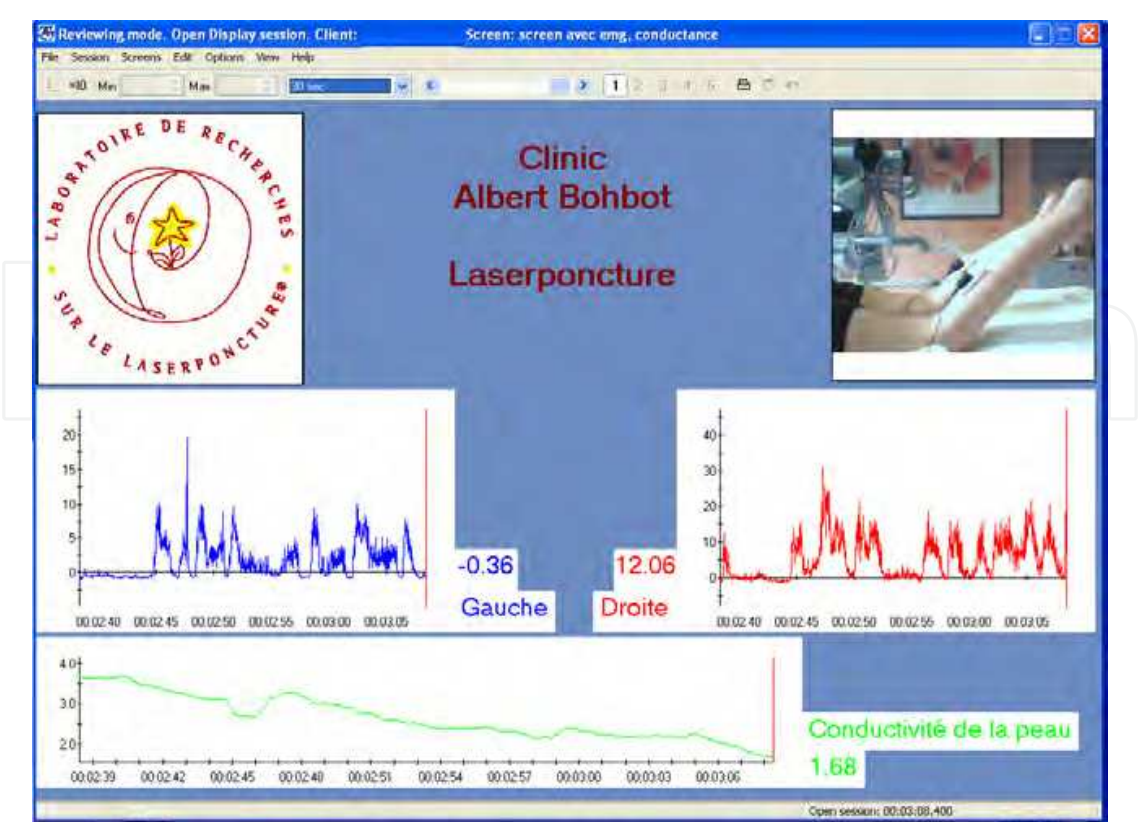


Fig. 5. Voluntary spontaneous muscle contraction (gastrocnemius muscles).

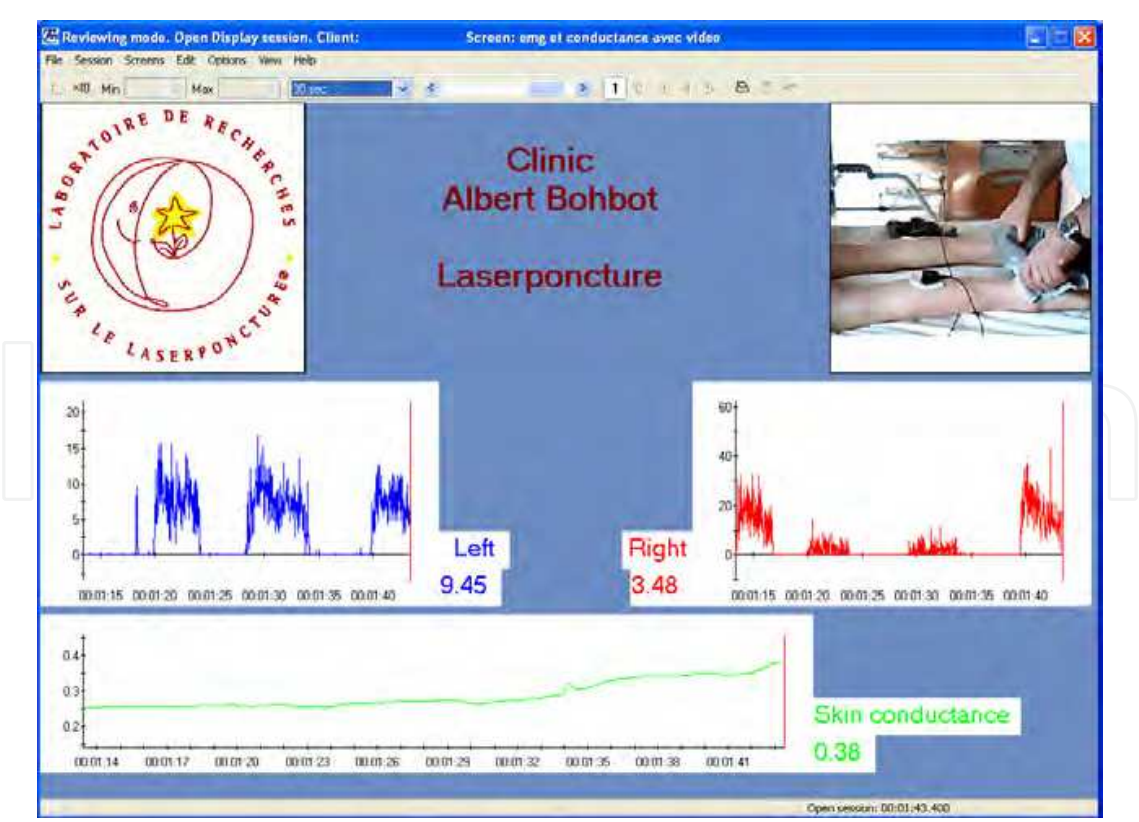


Fig. 6. Voluntary muscle contraction against resistance (gastrocnemius muscles; the operator's hand has no direct contact on the patient skin).

5. Positioning of captors

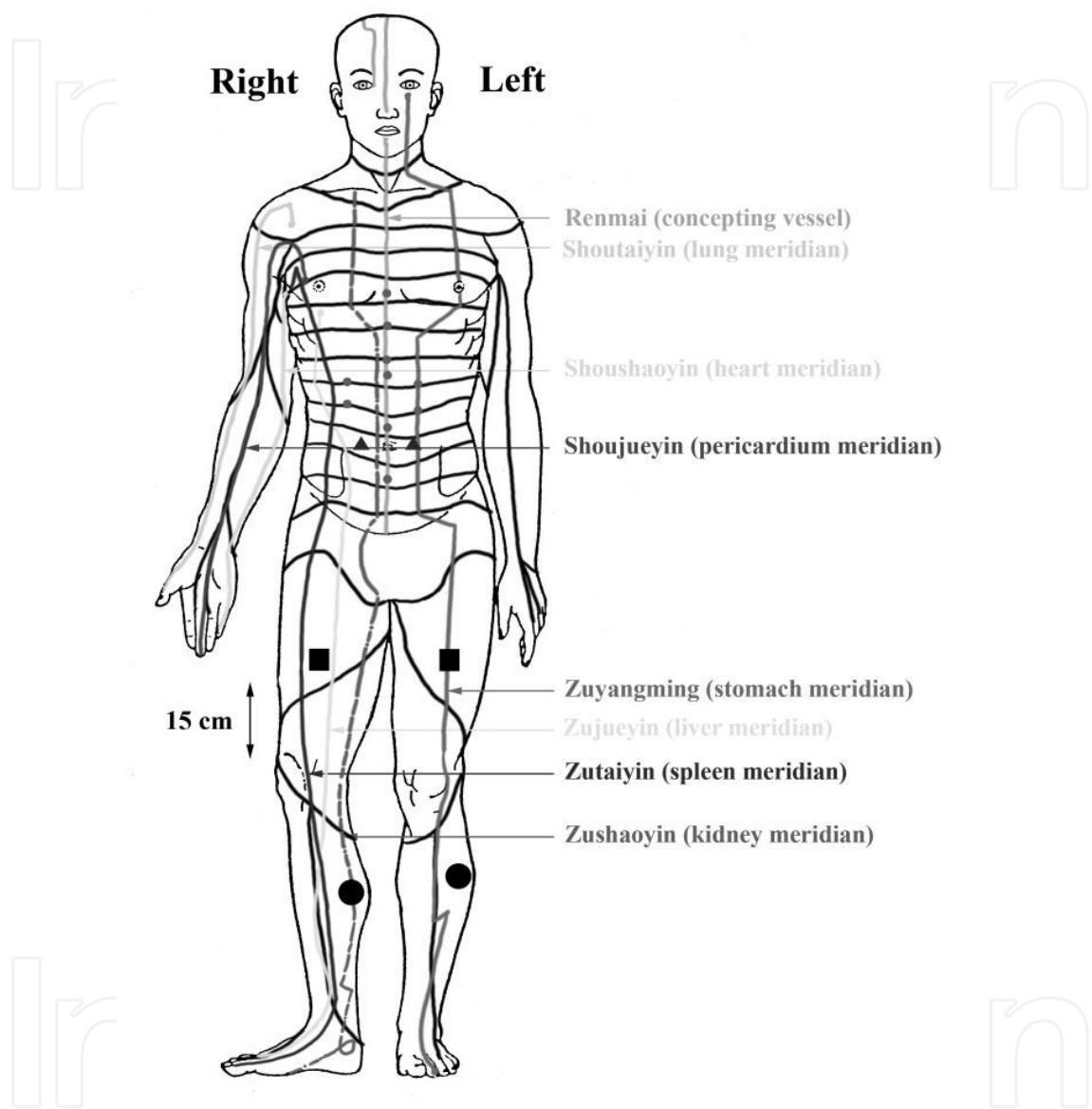


Fig. 7. Positioning of captors.

Front face

Squares: quadriceps

Triangles: abdominal muscles (upper, middle, and lower abdominal muscles)

Rounds: gastrocnemius

Other muscles can also be tested.

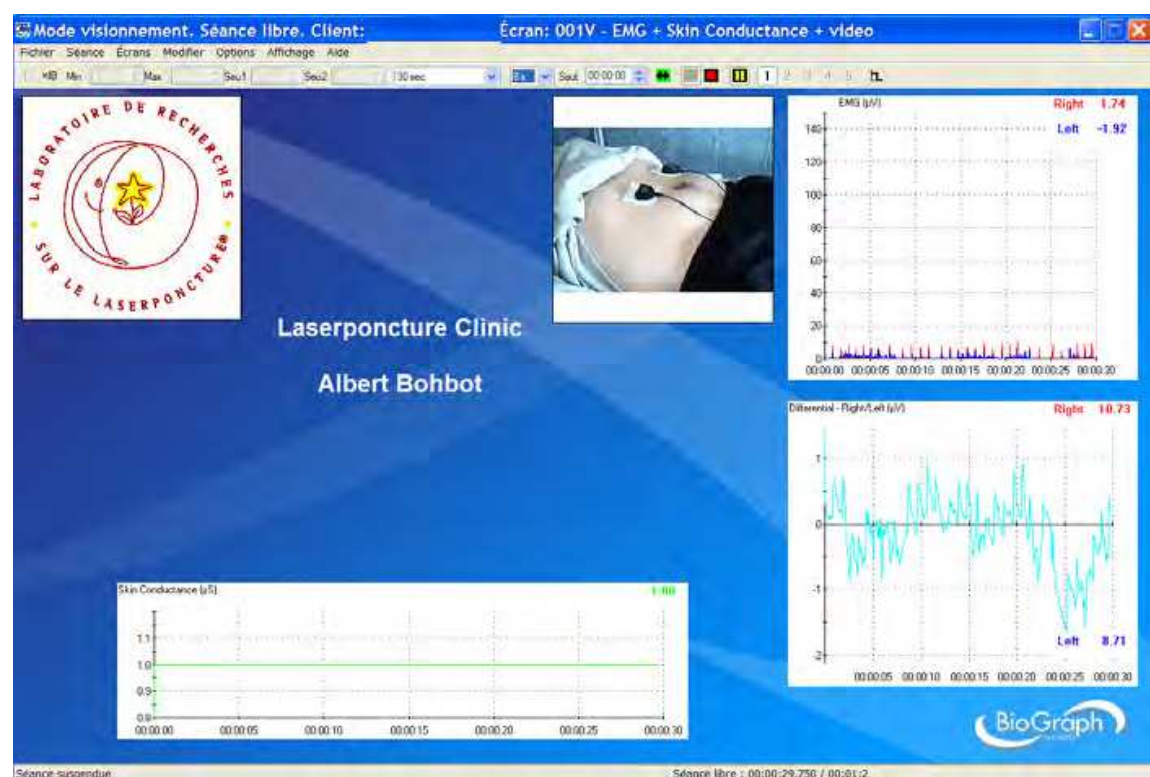


Fig. 10. Electromyography monitoring on March 17th, 2010 (upper abdominal muscles).

6.3 Quadriplegia with an incomplete SCI transection and Laserponcture® only



Fig. 11. MRI showing a C5-C6 incomplete SCI.

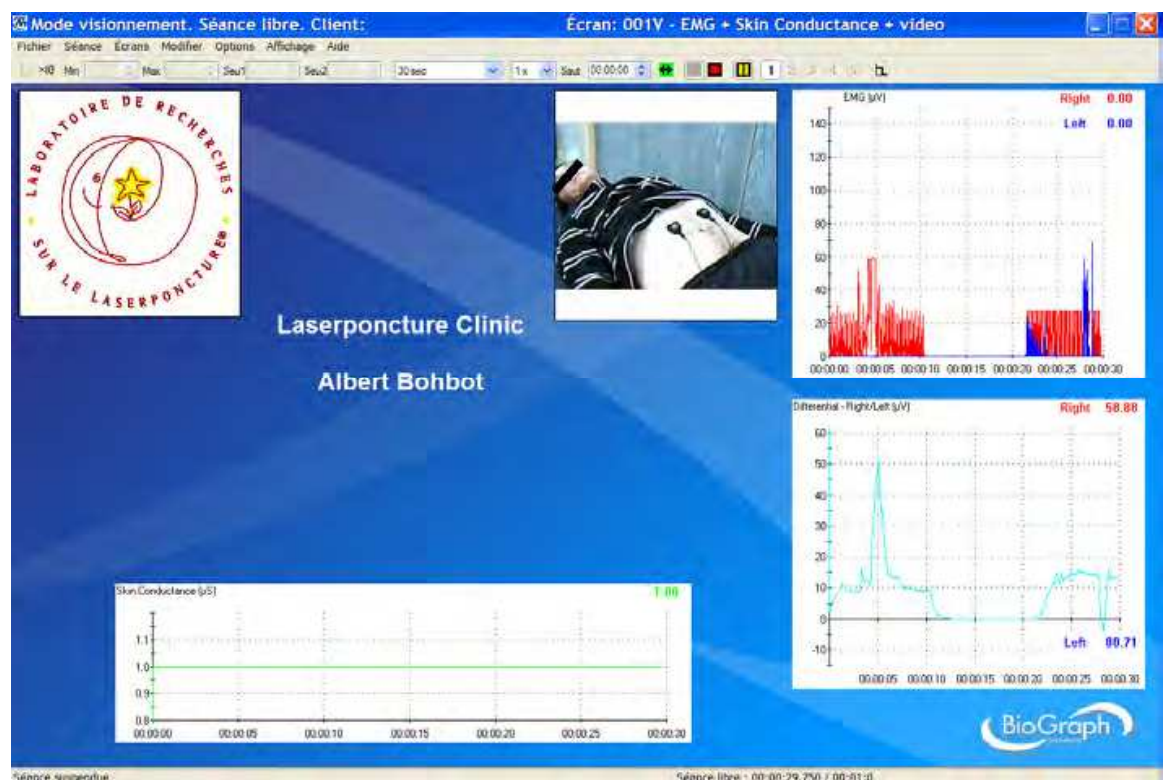


Fig. 12. Electromyography monitoring on January 12th, 2011 (upper abdominal muscles).

6.4 Quadriplegia with an incomplete SCI transection and Laserponcture[®] combined with cells (Nogo, Dr. Schwab's procedure)



Fig. 13. MRI showing a C6-C7 incomplete SCI.

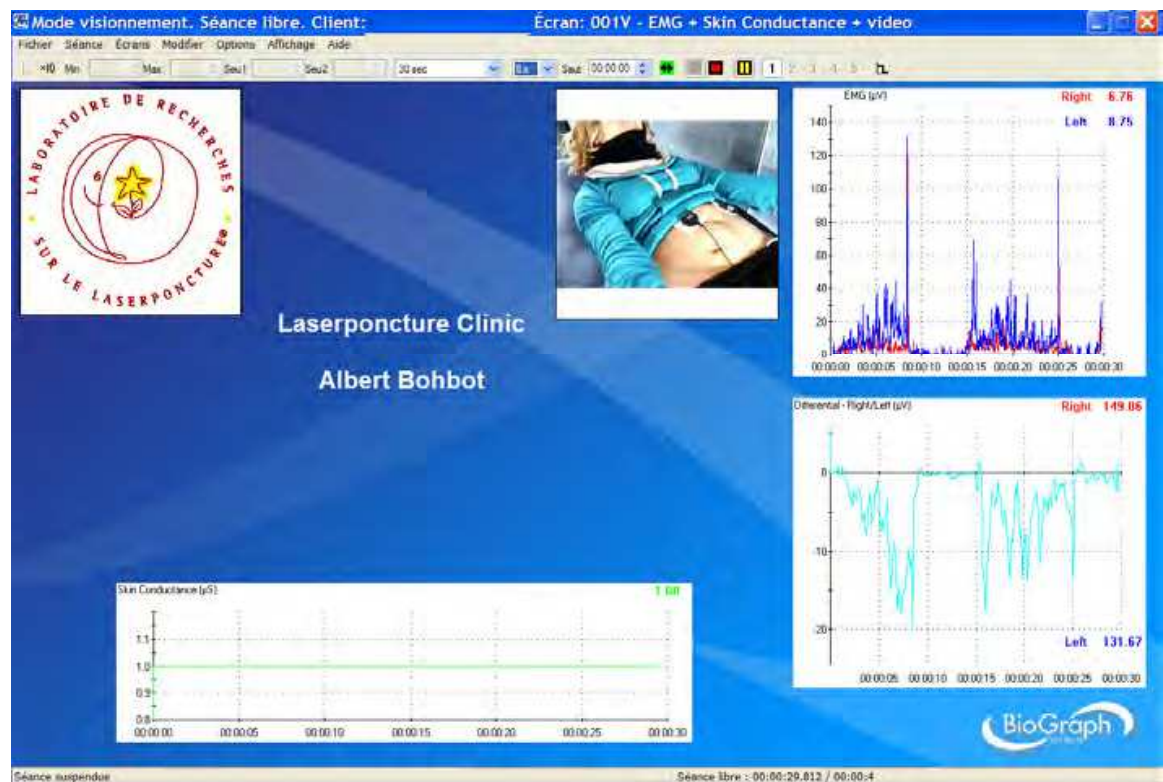


Fig. 14. Electromyography monitoring on February 28th, 2010 (upper abdominal muscles).

6.5 Paraplegia with a complete SCI transection and Laserponcture® only



Fig. 15. MRI showing a T12-L1 complete SCI.

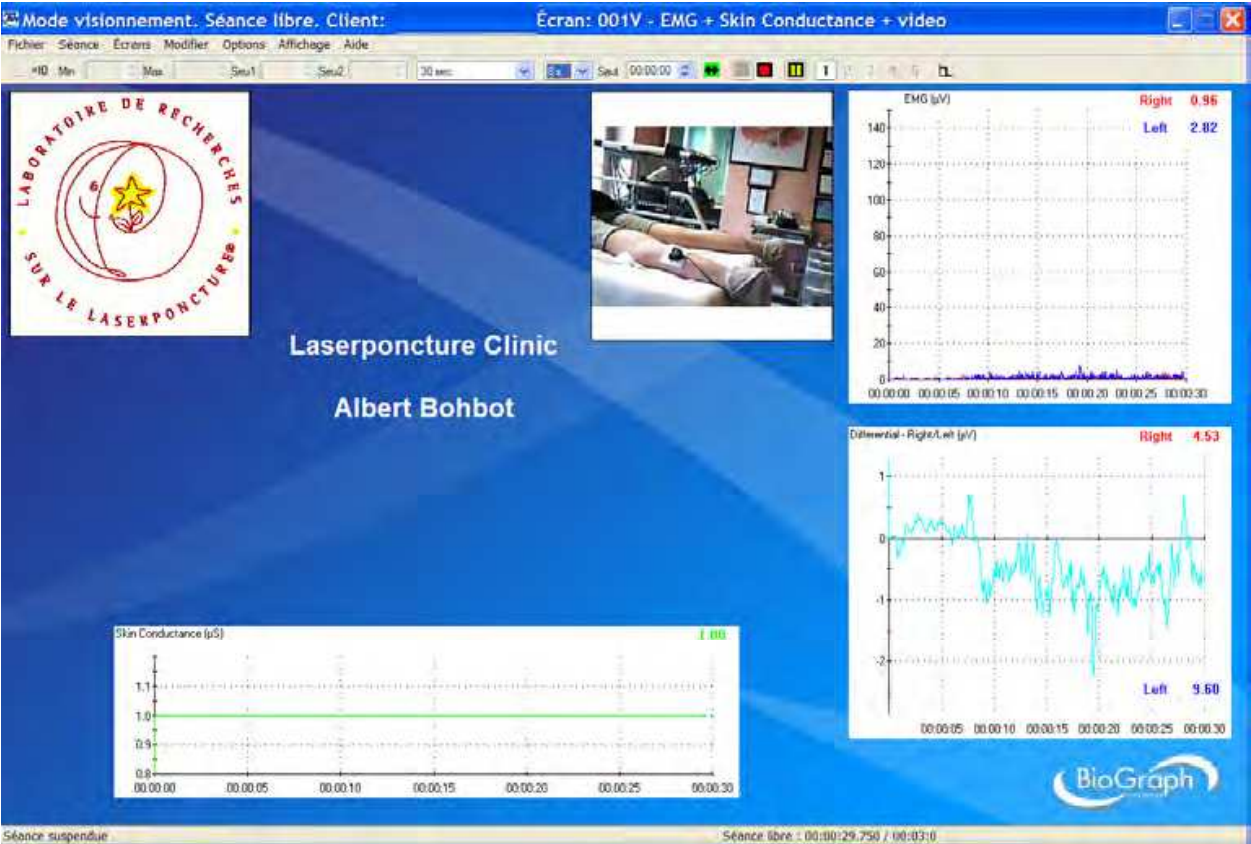


Fig. 16. Electromyography monitoring on February 9th, 2011, lateral gastrocnemius muscle.

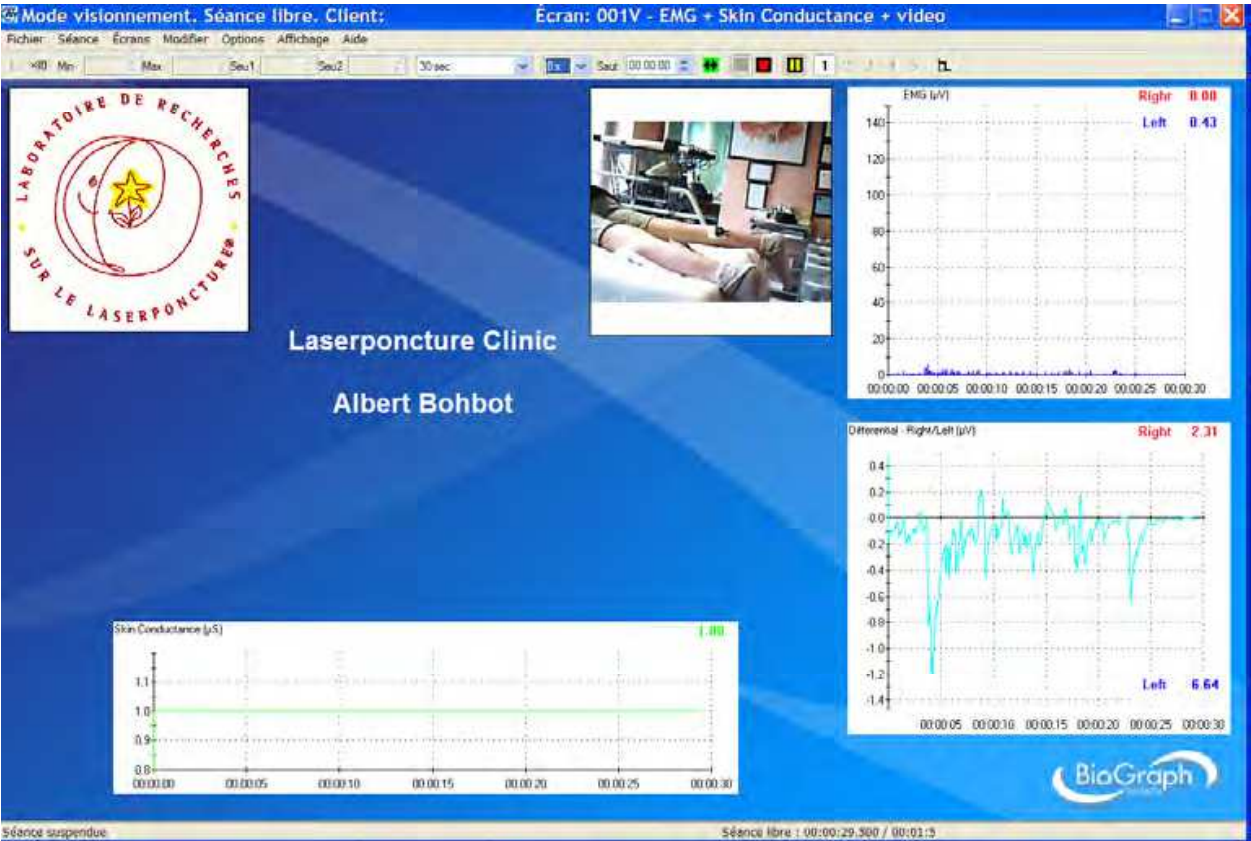


Fig. 17. Electromyography monitoring on February 9th, 2011, medial gastrocnemius muscle.

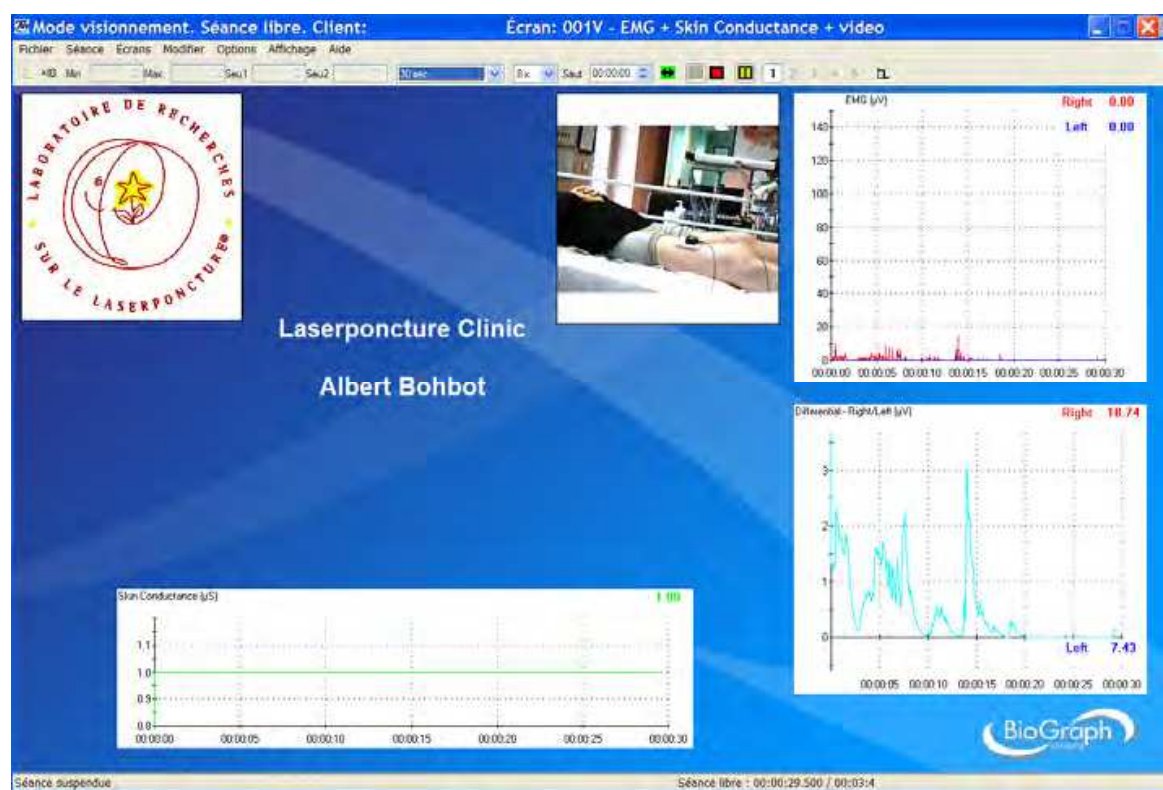


Fig. 18. Electromyography monitoring on February 9th, 2011, quadriceps.

6.6 Paraplegia with a complete SCI transection and Laserponcture® combined with olfactory ensheathing cells



Fig. 19. MRI showing a T10 complete SCI.



Fig. 20. Electromyography monitoring on November 22nd, 2010, quadriceps.

6.7 Paraplegia with an incomplete SCI transection and Laserponcture® only

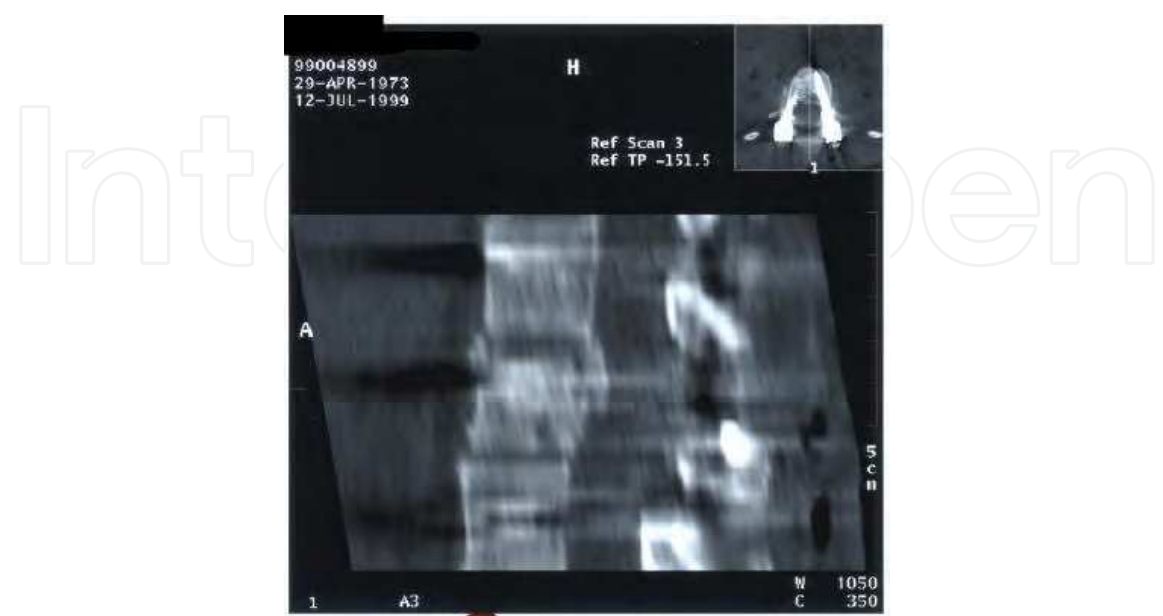


Fig. 21. MRI showing a L1 incomplete SCI.

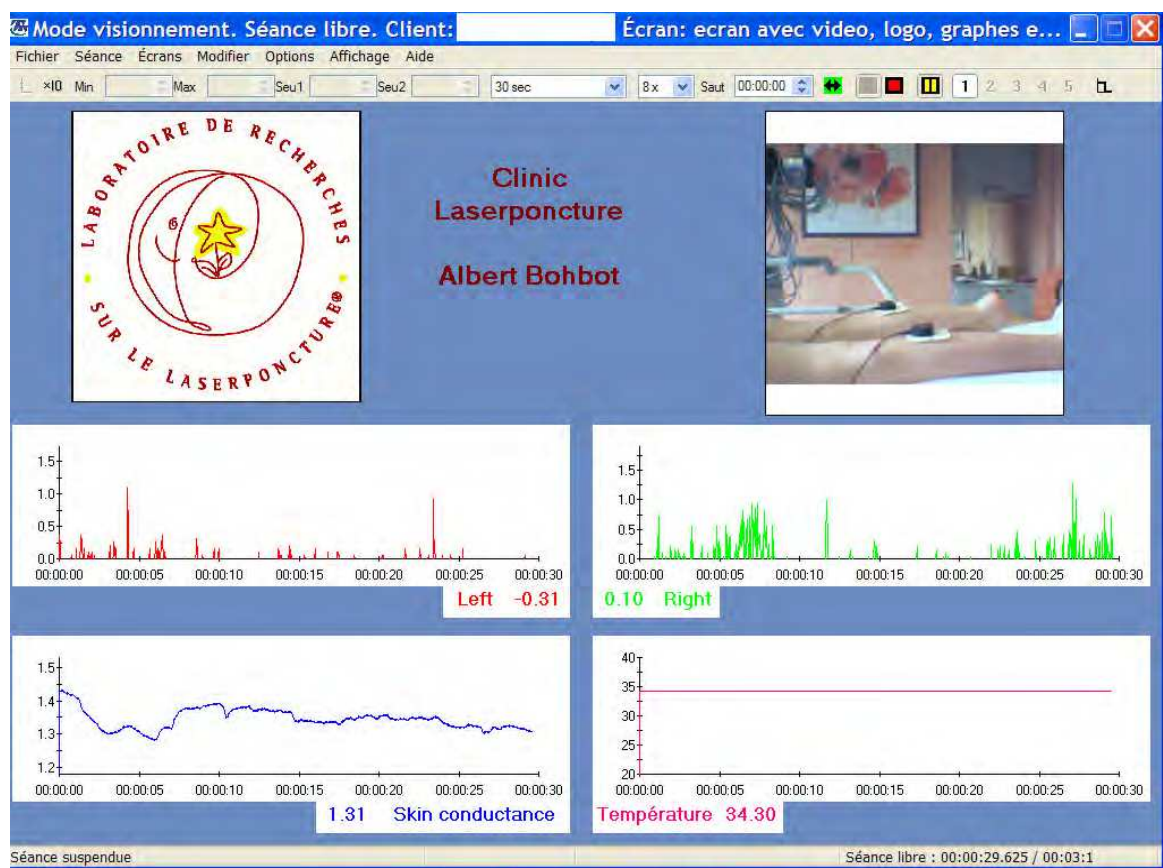


Fig. 22. Electromyography monitoring on February 26th, 2009, gastrocnemius muscles.

6.8 Paraplegia with an incomplete SCI transection and Laserponcture® combined with autologous hematopoietic cells



Fig. 23. MRI showing a T10-T11 incomplete SCI.

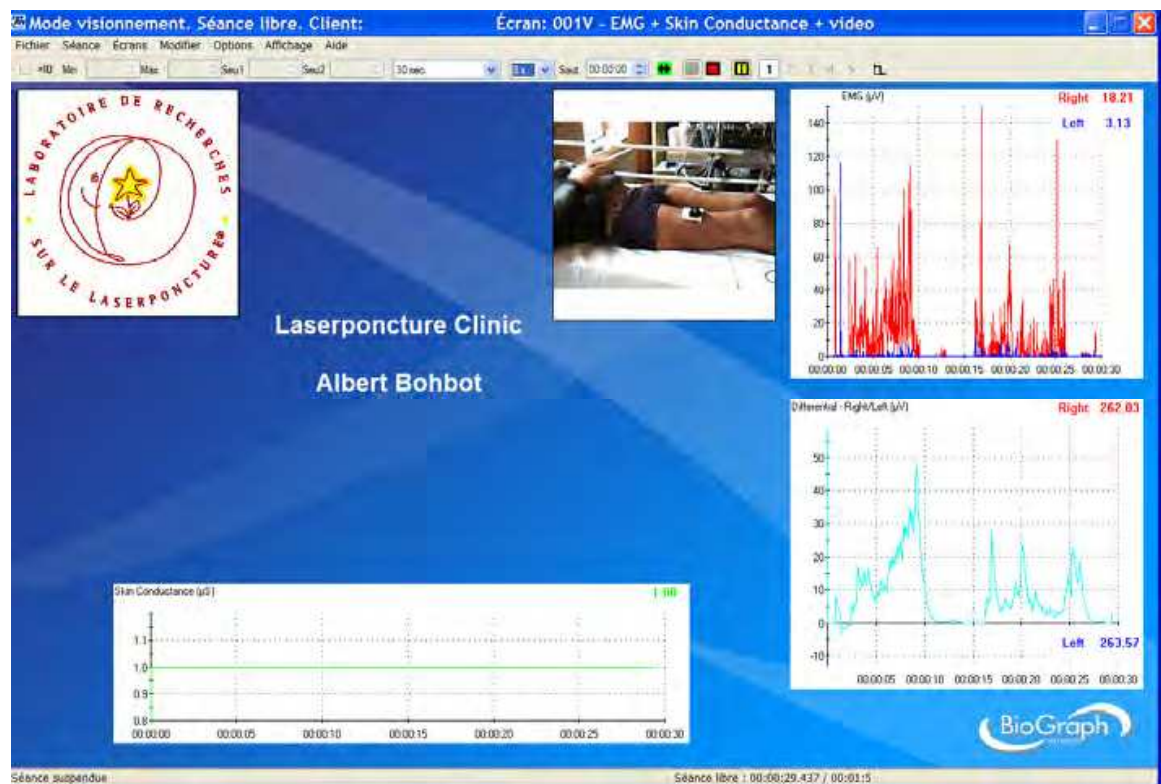


Fig. 24. Electromyography monitoring on January 26th, 2011, quadriceps.

7. Conclusion

This chapter underlines that it is important to track voluntary muscle activity below a SCI in order to possibly determine recoveries to come.

Electromyography monitoring suggests that there is muscle activity even though it may not be visible.

Despite a complete transection of the spinal cord, it also suggests that back-up networks develop to carry the brain orders through the body. It also shows that the information can be transmitted through other means, such as wavelengths, when there is a **complete anatomical transection** of the spinal axis, that is a tissue discontinuity preventing neurotransmitters to travel through synapses.

The information sent by the brain goes from an electrochemical state (neurotransmitters) to an electromagnetic state (wavelengths).

It also suggests that the brain deals with two languages of different nature, the electrochemical transmitter and the electromagnetic signal, which can relay each other.

8. Acknowledgement

Edwige Nault for her translation.

9. References

Bohbot, A. (2002). LASERPONCTURE®: an alternative for SCI. Fourth international symposium on experimental spinal cord repair and regeneration. Brescia, Italy. March 2002.

- Bohbot, A. (2008). LASERPONCTURE® contribution in neural restoration. First international association of neurorestoratology annual conference. Beijing, China. May 2008.
- Bohbot, A. (2008). Preliminary study on the muscle activity below the injury in complete paraplegia and quadriplegia treated by LASERPONCTURE® and monitored by electromyoscan and thermal camera. The Seventh international congress of the world association of laser therapy. Sun City, South Africa. October 2008.
- Bohbot, A. (2009). OECs and LASERPONCTURE® from 2005 to today: follow-up and progress. Second international association of neurorestoratology annual conference. Beijing, China. April 2009.
- Bohbot, A. Olfactory Ensheathing Glia Transplantation Combined with LASERPONCTURE® in Human Spinal Cord Injury: Results Measured by Electromyography Monitoring. *Cell Transplantation*. Vol.19, (2010), pp. 179-184.

IntechOpen



Applications of EMG in Clinical and Sports Medicine

Edited by Dr. Catriona Steele

ISBN 978-953-307-798-7

Hard cover, 396 pages

Publisher InTech

Published online 11, January, 2012

Published in print edition January, 2012

This second of two volumes on EMG (Electromyography) covers a wide range of clinical applications, as a complement to the methods discussed in volume 1. Topics range from gait and vibration analysis, through posture and falls prevention, to biofeedback in the treatment of neurologic swallowing impairment. The volume includes sections on back care, sports and performance medicine, gynecology/urology and orofacial function. Authors describe the procedures for their experimental studies with detailed and clear illustrations and references to the literature. The limitations of SEMG measures and methods for careful analysis are discussed. This broad compilation of articles discussing the use of EMG in both clinical and research applications demonstrates the utility of the method as a tool in a wide variety of disciplines and clinical fields.

How to reference

In order to correctly reference this scholarly work, feel free to copy and paste the following:

Albert Bohbot (2012). Electromyography Monitoring for Complete and Incomplete Transections of the Spinal Cord in Humans Who Received a Cell Therapy Combined with LASERPONCTURE® or LASERPONCTURE® Only: Methodology, Analysis, and Results, Applications of EMG in Clinical and Sports Medicine, Dr. Catriona Steele (Ed.), ISBN: 978-953-307-798-7, InTech, Available from:

<http://www.intechopen.com/books/applications-of-emg-in-clinical-and-sports-medicine/electromyography-monitoring-for-complete-and-incomplete-transections-of-the-spinal-cord-in-humans-wh>

INTECH
open science | open minds

InTech Europe

University Campus STeP Ri
Slavka Krautzeka 83/A
51000 Rijeka, Croatia
Phone: +385 (51) 770 447
Fax: +385 (51) 686 166
www.intechopen.com

InTech China

Unit 405, Office Block, Hotel Equatorial Shanghai
No.65, Yan An Road (West), Shanghai, 200040, China
中国上海市延安西路65号上海国际贵都大饭店办公楼405单元
Phone: +86-21-62489820
Fax: +86-21-62489821

© 2012 The Author(s). Licensee IntechOpen. This is an open access article distributed under the terms of the [Creative Commons Attribution 3.0 License](https://creativecommons.org/licenses/by/3.0/), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

IntechOpen

IntechOpen