Pressure Ulcer Formation Prevention in Paraplegics using Computer and Sensory Substitution via the Tongue

First Steps in a Sustainability Study

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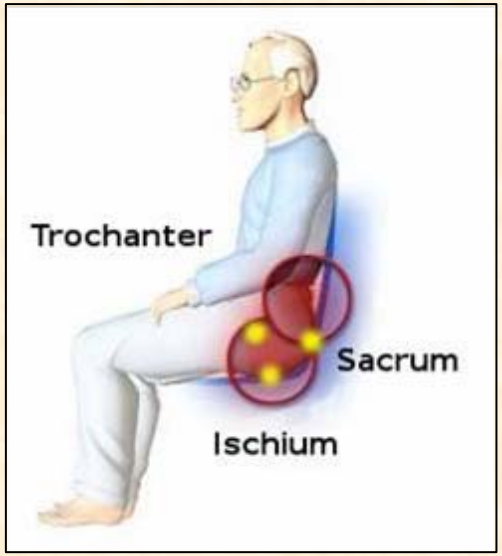
WHAT IS A PRESSURE ULCER?

Pressure Ulcer

- « Working definition *(EPUAP)* : a pressure ulcer is an area of localized damage to the skin and underlying tissue caused by pressure, shear, friction and or a combination of these. »

Most Common Sites

- Ischium
- Sacrum
- Trochanter



Consequences

- Main cause of rehospitalization for patients with paraplegia
- a - Aggravation of existing pathologies ***(septicemia)***
- b - Functional, psychological and social outcome
- c - Increase in health care costs.

A NEW APPROACH

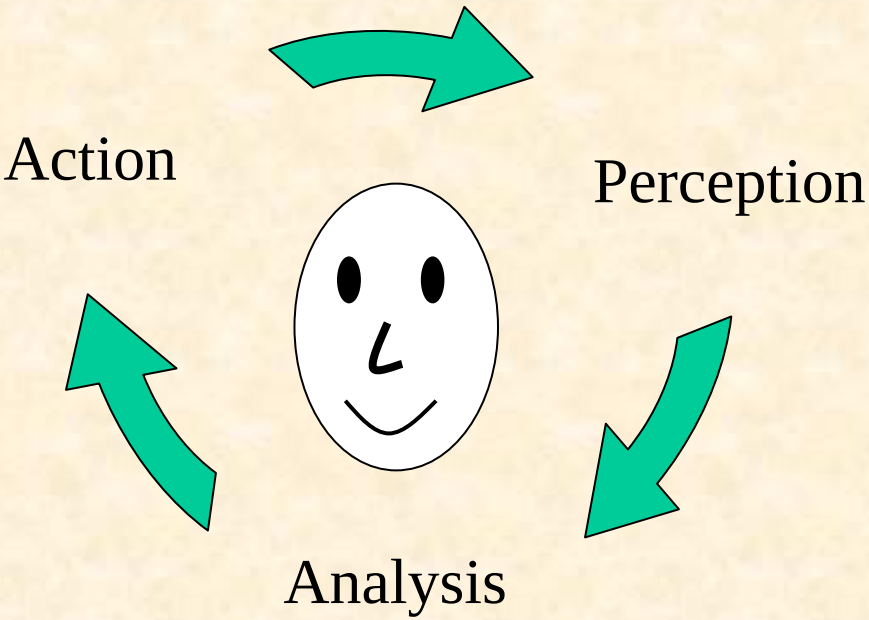
Why do pressure ulcers occur in paraplegics?

Healthy Subject

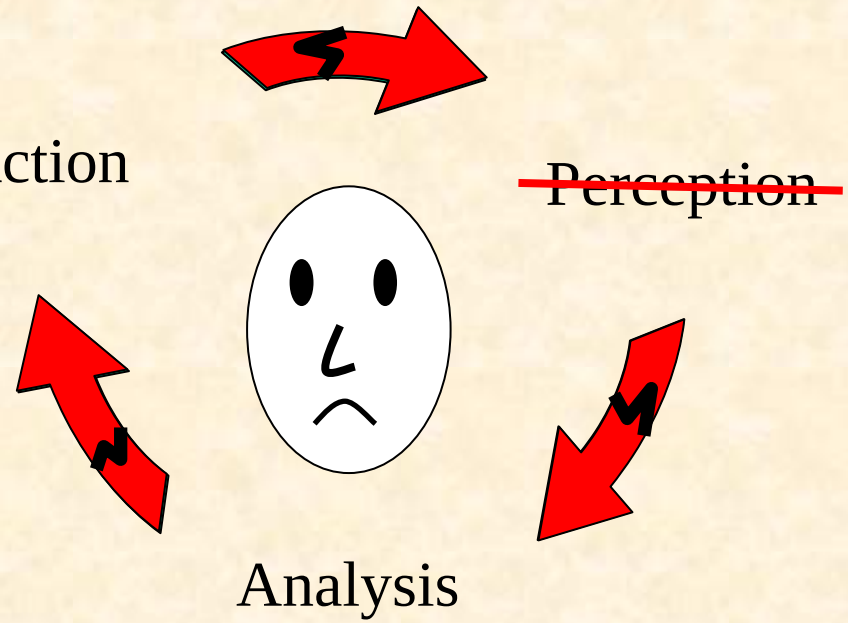
Paraplegics

Control loop for pressure ulcers formation prevention

Functional



Not Functional



A NEW APPROACH

To restore Perception by using **SENSORY SUBSTITUTION** but

- Auditory modality
- Visual modality

are already very often used in everydaylife.

Another « way » of communication ?

Tactile sensory modality of the TONGUE

Sensory and motory nervous pathways for the tongue are preserved in paraplegia after spinal cord injury.

A NEW APPROACH

Literature

P Bach-Y-Rita

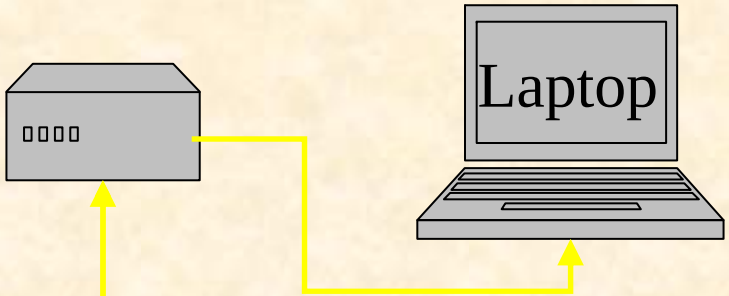
- « **We do not SEE with the eyes** » : the visual image does not go beyond the retina, where it is turned into patterns of pulses along nerves. It is the brain which recreates the image from the patterns of pulses.
- **Tactile Vision Substitution System (TVSS)**
  - To deliver visual information from a TV camera to arrays of stimulators in contact with the skin of one of several parts of the body (abdomen, back, forehead, fingertip, …)
  - To perform complex perception and “eye”-hand coordination tasks
- **TONGUE INTERFACE**
  - Oral perceptual and sensory capacities have long been recognized to be superior to other tactile areas
  - the electrode geometry and driving circuitry can be simplified for tongue possibly because the electrode-skin interface on the tongue is very different from that on the fingertips.
  - A cosmetically acceptable interface built into an orthodontic retainer, with FM transmission of the signals from the artificial sensor carrying the information wirelessly to the tongue device unit for relay to the brain.

A NEW APPROACH

Literature

- **No such approach** exists for the pressure ulcer prevention
- To develop and use a new device
  - Pressure Mapping System
  - Tongue Display Unit
  - Laptop

A NEW APPROACH

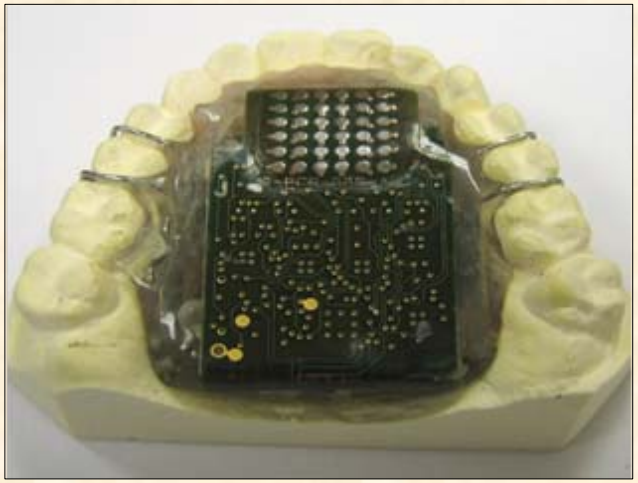


Real time reliable wireless transmission

The pressure mapping system

A pressure mapping system connected to a laptop

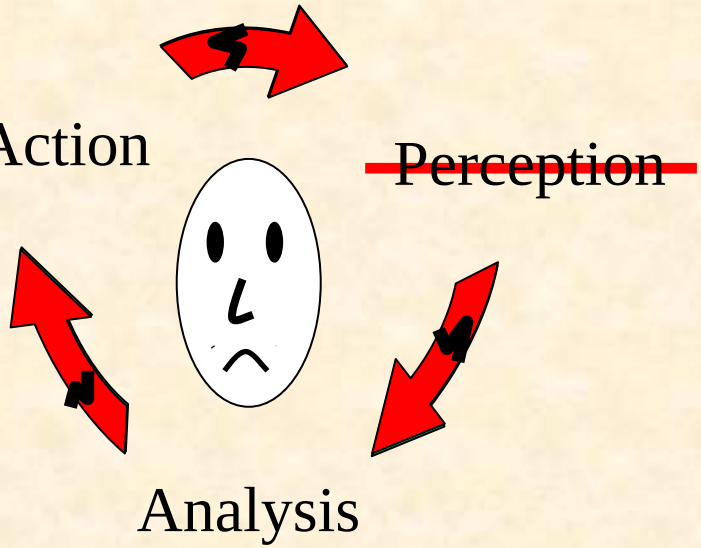
A human-machine interface into an orthodontic retainer with real-time reliable wireless transmission from the laptop to the TDU.

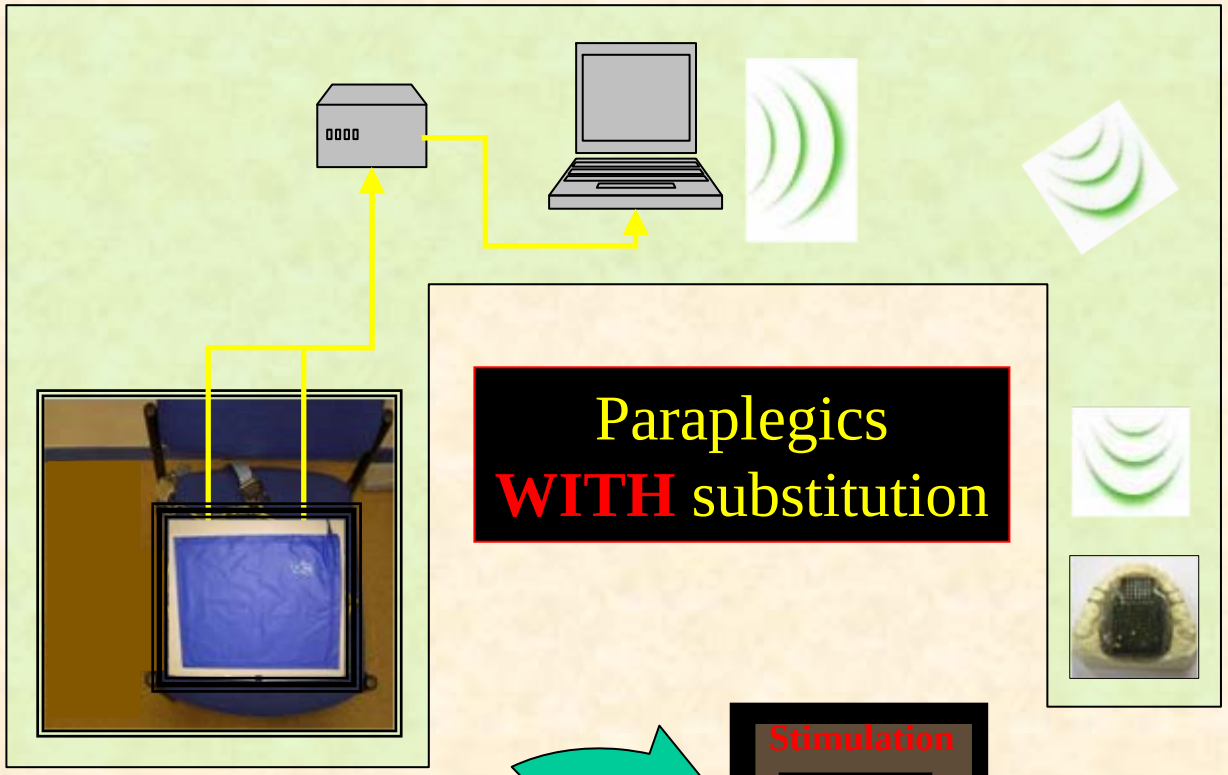


The human-machine interface into an orthodontic retainer

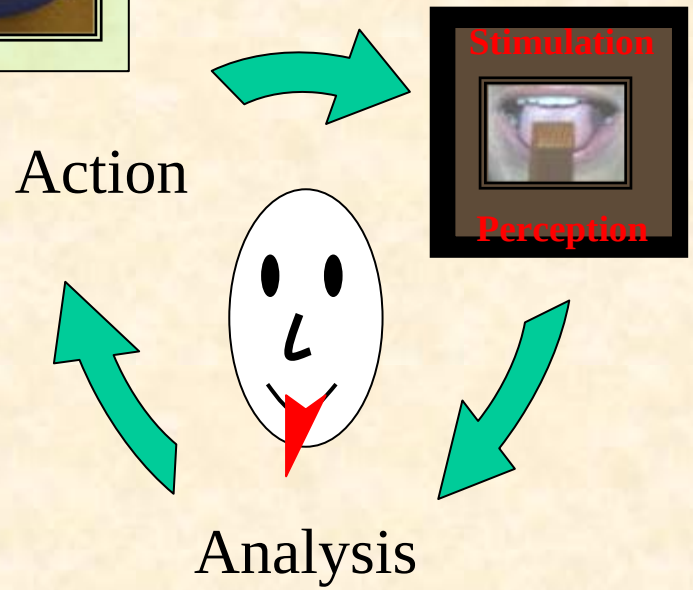
A NEW APPROACH

Paraplegics
without substitution

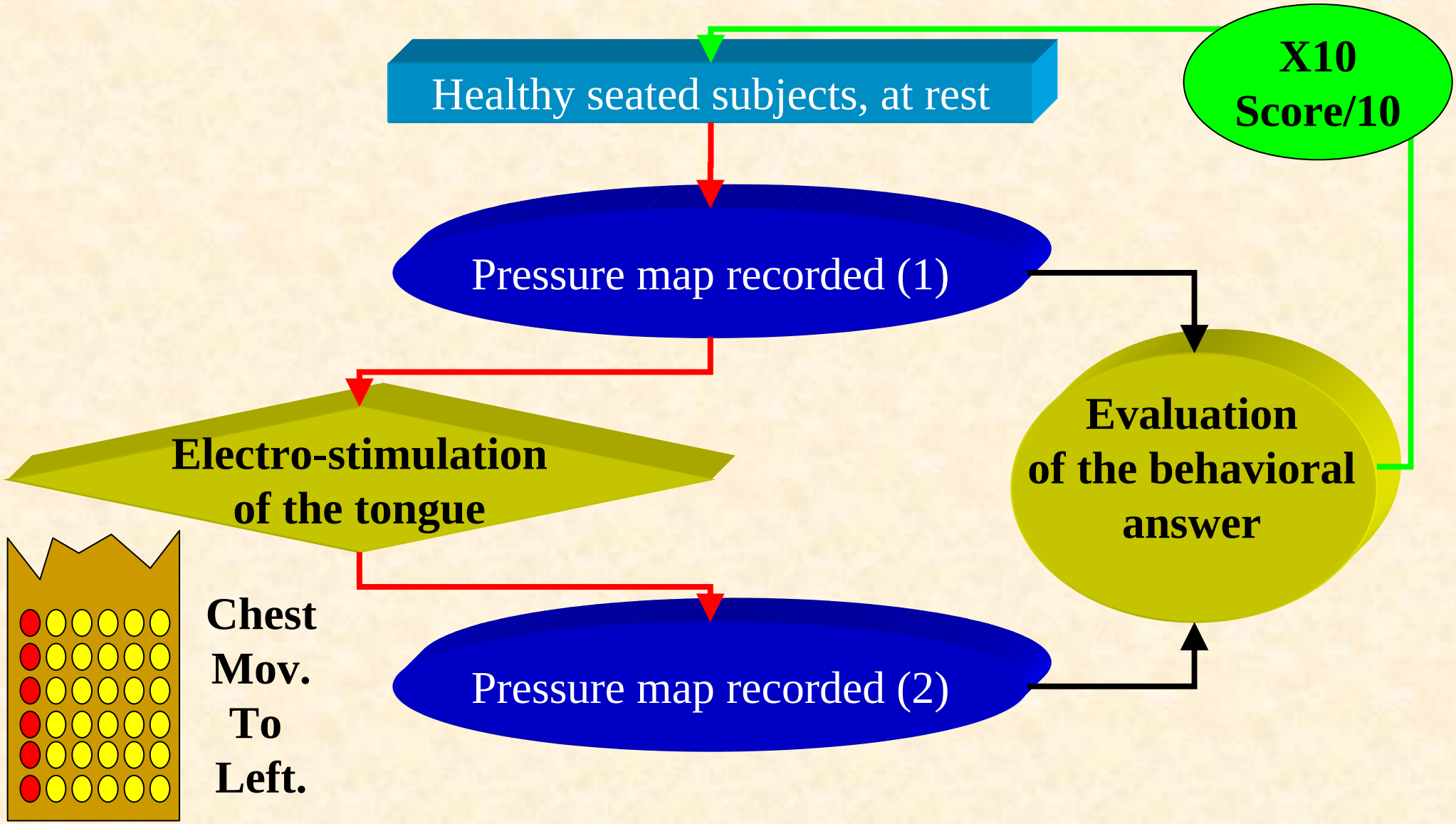




Paraplegics
WITH substitution



PRELIMINARY STUDY



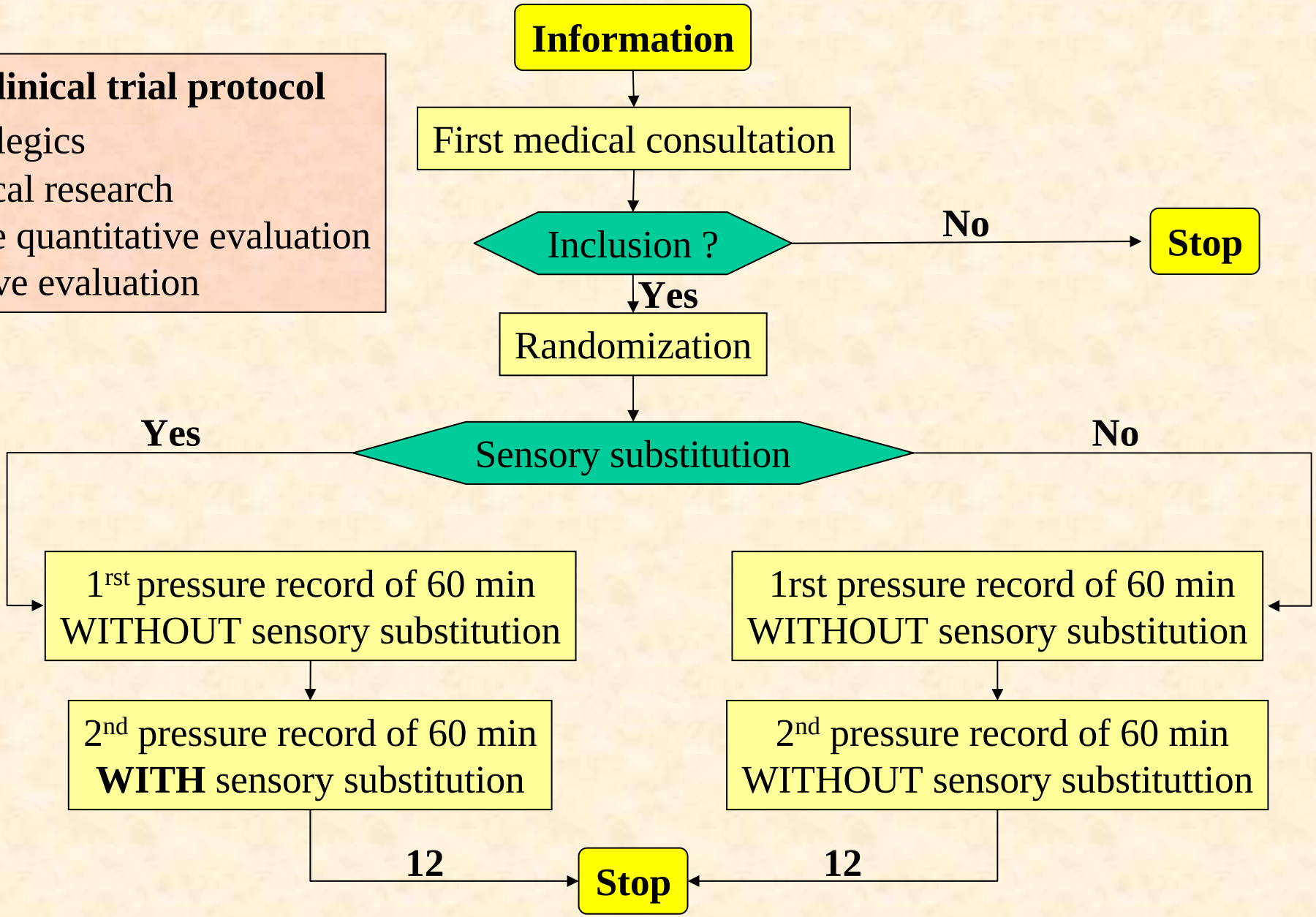
RESULTS

Population	10 healthy subjects 100 scores marked out of 10
Clinical protocol	Electro-stimulation of the tongue was well accepted Protocol realized totally
Results	Score : 9.2 +/- 0.79 (8-10) Perception-Analysis-Action

APPLICATIONS

Current clinical trial protocol

- 24 paraplegics
- Biomedical research
- Objective quantitative evaluation
- Qualitative evaluation



Thanks for your attention

References

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