

Why Reconstructive Neurosurgery?

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ABSTRACT

Spine and peripheral nerves reconstructive surgery, central nervous system revascularization (surgical, radiointerventional), neuromodulation, bioengineering and transplantation are the recent tools to promote reconstruction, restoration and rehabilitation.

The ISRN is an "open" multidisciplinary Society in evolution. Many different souls inspire new trends in many different neurosurgical fields, all dealing with "neurosurgical reconstruction". Spinal, functional, vascular, radio and oncologic neurosurgeons are the addressees of our proposal along with biologists, bioengineers, anatomists physiologists, physiotherapists who are precious and irreplaceable inspirers. These are the three key words of our creed and all fulfill the aim of ISRN, dealing with mechanical morphological and functional restoration.

Keywords: Neurosurgical reconstruction, Neurosurgical restoration, Neurosurgical rehabilitation

INTRODUCTION

Founded in 1955, the WFNS is a professional, scientific, non-governmental organization comprising 5 Continental Associations, 115 National Neurosurgical Societies and 7 Affiliate Societies, representing some 30,000 neurosurgeons worldwide. The World Federation of Neurosurgical Societies (WFNS) aspires to promote global improvement in neurosurgical care, training and research to benefit the patients. The WFNS is governed by an Executive Committee consisting of two Delegates from each Member Society and an Administrative Council composed of the Officers of the Federation, who are elected every four years. The EC meets every two years and is guided by the Administrative Council which meets at least annually.

The goals of the WFNS are deliberated and pursued through scientific, standing and ad hoc committees and during the International Congress of Neurological Surgery which takes place every four years. The Neurorehabilitation and Reconstructive Neurosurgery Committee (NRNC) is a special Section which promotes all those activities of the WFNS aiming at implement and promote all the restorative, reconstructive and augmentative neurosurgical procedures, grossly identified in the past as the Functional Neurosurgery subspecialty but now updating, evolving and merging with neuro oncology, spine surgery neuroradiological and neurophysiological intraoperative assistance and new technologies lato sensu. As matter of fact the Neuromodulation Committee is a different Section and it is administered by a completely different Board working in an

independent way and pursuing different objectives. Two years after the institution of the WFNS Committee, the members of the Board of the Neurorehabilitation and Reconstructive Neurosurgery Committee felt the need to found a new Society, more free to deal with other Medical and /or Surgical Societies and expert researchers of different branches of biology, physiology, physiotherapy. The IV International Congress of International Society of Reconstructive Neurosurgery (ISRN) along with the VII Neurorehabilitation and Reconstructive Neurosurgery Symposium (WFNS) was held in Cerveteri (Rome) on SEPTEMBER the 12th – 14th, 2015. The President of the Congress was Prof Franco TOMASELLO, former Rector of the University of Messina Italy and actually Vice President of WFNS and myself Massimiliano VISOCCHI, Past President of the Italian Society of Neurosonology and Cerebral Haemodynamics, former Secretary of the Spine Section of the Italian Society of Neurosurgery, Associate Professor in Neurosurgery at the Catholic University of

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of Rome and Visiting Professor at the Shanghai Jiao Tong University School of Medicine. In such an occasion I was appointed President Elect of the ISRN and soon after I started to ask to myself some more questions dealing with Reconstructive Neurosurgery and also to try to better investigate on the true roots of our Society and the supposed mission of ISRN. In other words “were we come from? Who are we and where are we going?”

Now, also as Chairman Elect of the NRNC my main impulse is to have a look on the current literature on the topic. If we search for “Reconstructive Neurosurgery” on Pub Med. Gov the US National Library of Medicine National Institute of Health we can find 3849 papers updated at April 2018 the 11th. The papers are spanning from the latter, printed on April 2018 and harbouring a very intriguing title: Independent factors affecting postoperative complication rates after custom-made porous hydroxyapatite cranioplasty: a single-center review of 109 cases [1] to the former, the very first recognized paper, printed on November 1947 and dealing with A report of the early results in tantalum cranioplasty [2]. In between these papers there are many others dealing with craniofacial endoscopy [3], spinal instrumentation and fusion procedures [4], peripheral nerves reconstructive procedures [5], vascular reconstructive and cerebral blood flow restorative surgical procedures [5], neuronavigation and video assisted neurosurgical procedures [6], craniofacial complex surgical procedures [7], intraoperative neuromonitoring [8]. Surprisingly many paper dealing with genetics, bio molecular and cytochemical studies dealing with central and peripheral nervous system are available as well [9]. Reconstruction is intended in a pure mechanical way and no concepts dealing with restoration or rehabilitation arise from the lines of the majority of the manuscripts but just a simple exposition of surgical techniques and procedures aiming at just repairing something. More in details even “dysfunctional” syndromes as Raynaud syndrome are faced with mechanical procedures instead of neuroaugmentative ones [10].

Neurosurgeons know very well that central nervous system, along with the spine and the skull bone components, has an intrinsic pattern of complex physiological nature both from the neuro - chemical and the biomechanical point of view. Starting from the Neurorehabilitation Committee of the WFNS experience, we turned our gaze toward restoration and rehabilitation very soon and now, since ISRN is an "open" multidisciplinary Society in evolution, we first intended neurosurgical reconstruction, *latu sensu*, in a new way: reconstruction means also rehabilitation and restoration.

Nevertheless in the common literature restoration is strongly linked to the concept of reconstruction as demonstrated by the title of the following paper included in the Pub Med list

of Reconstruction: Restoration of the orbital aesthetic subunit with the thoracodorsal artery system of flaps in patients undergoing radiation therapy [11].

Otherwise neurorehabilitation has different sounds and significances in the culture of the neurosurgeons; although it still deal with reconstruction e. g Functional restoration of diaphragmatic paralysis: an evaluation of phrenic nerve reconstruction [12] and also with replantation as described in in the paper Six years of follow-up after bilateral hand replantation [13], functional neurorehabilitation merges with the concept of neuromodulation and neuromodulation is the core of the functional neurosurgery. So more simply spine and peripheral nerves reconstructive surgery, central nervous system revascularization (surgical, radiointerventional), neuromodulation, bioengineering and transplantation are the recent tools to promote reconstruction in the special sense intended by our Society.

More in details neuromodulation classically deals with is the physiological process by which a given neuron uses one or more neurotransmitters to regulate diverse populations of neurons. This is in contrast to classical synaptic transmission, in which one presynaptic neuron directly influences a single postsynaptic partner. Neuromodulators secreted by a small group of neurons diffuse through large areas of the nervous system, affecting multiple neurons. Otherwise in the surgical praxis the meaning shifted toward all the surgical tools armamentarium dealing with all the procedures involved in CNS electrical and chemical stimulation as performed with spinal cord stimulation (SCS) deep brain stimulation (DBS), cortical brain stimulation (CBS) drug delivery systems implantation (DDS) aimed at facing with pain, movement disorders, spasticity, bowel and bladder dysfunction, peripheral heart and cerebral vasculopathies. Interestingly an interference of SCS was first reported by Hosobuchi in 1986 also with CBF; he reported the intriguing effect of SCS on CBF in human beings, along with the demonstration that spinal cord stimulation can improve peripheral blood flow. Following these initial clinical and experimental observations, he first described the use of cervical SCS for the treatment of cerebral ischemia in man in 1991 [14].

Others have reported that SCS improves clinical symptoms of patients in persistent vegetative states, improves CBF in stroke patients, suppresses the hemodynamic mechanism underlying headache attacks in migraneous patients, and increases locoregional blood flow in high grade brain tumours in humans. In animals, SCS has been shown to prevent progression of cerebral infarction, reduce infarct volume, reduce ischemic brain edema and improve vasospasm [15]. Studies of our group have produced variable results: SCS can produce an increase of CBF, a reduction or no effect. In patients studied with both single photon emission cerebral tomography (SPECT) flowmetry

and Transcranial Doppler Sonography (TCD) the size of the induced variations, when present in both, was the same. Cervical stimulation more frequently produces an increase in CBF (61% of cervical stimulations) [16-18]. Experimental studies of our group confirmed that SCS 1) interacts with CO₂ with the mechanism of regulation of CBF in a competitive way and produce a reversible functional sympathectomy; 2) produces similar flowmetric changes in the brain as well as in the eyes; 3) can improve both clinical and hemodynamic ischemic stroke in humans, 4) prevents hemodynamic deterioration in the experimental combined ischemic and traumatic brain injury; and 5) prevents experimental early vasospasm [19-21]. On the other hand, trigeminal ganglion stimulation can have opposite effects [22].

But when we speak about reconstruction we cannot forget spinal cord and spine surgery, both surgical challenges, from a bio functional point of view the former and from a bio mechanical point of view the latter. Instrumentation and fusion procedures from the upper to the lower levels of the spine have been widely published so far [23-28]. Nevertheless the choice of alternative minimally invasive video assisted surgical routes for spine reconstruction have got also a big deal of interest and opened new perspectives in reconstruction, rehabilitation and restoration which are the three key words of our creed and all fulfill the aim of ISRN, dealing with mechanical morphological and functional restoration [29-35].

Spinal, functional, vascular, radio and oncologic neurosurgeons are the addressees of our proposal along with biologists, bioengineers, anatomists physiologists, physiotherapists who are precious and irreplaceable inspirers.

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