**The study of the “bands of Fontana” hints at a model of nerve structure**

**which can be concurrent with brain plasticity in functional recovery**

**Antonio Merolli, MD**

Orthopaedic Surgery at “Gemelli” Medical School, The Catholic University in Rome, Italy

**Introduction.** By the end of the 18th century the anatomist Felice Fontana described the structure of peripheral nerve, highligthing transverse and oblique bands clearly visible at low magnification. These bands appear like spirals able to lengthen or shorten in accordance to the stretching of the nerve. Fontana demonstrated that the bands are optical illusions created by the arrangement of nerve fibers. Following Authors tried to demonstrate the mechanism for the visualization of the bands and ascribed alternatively to the Perineurium or to the Endoneurium the role of structural determinant of the bands. However, optical and electronic microscopy always failed to identify any peculiar components which can be able to explain the phenomenon of the bands.

**Materials and Methods.** We studied the bands of Fontana in the Sciatic Nerve of the Wistar Rats. We made careful dissections and we digitally video-recorded at high-speed the recoiling of the bands. We, then, produced computer-graphic generated images by trasposing the anatomical data into a mathematical model. This was based on the fact that optical phenomena can be reproduced by computer imaging. We compared the computer generated images with the real images of the bands and we found great similarity.

**Results.** In-vivo microdissection showed distinctive black/white highly packed bands as far as the perineurium remains intact. These bands are different from the widely spaced, translucent dark/pale grey, staggered bands which are visible inside the endoneurium and after the perineurium has been sectioned. Computer merging of these two patterns produced images resembling the bands in-vivo. So, we concluded that two repetitive (spiralling) structures, with different characteristics (pitch), one located in the perineurium and another in the endoneurium, do merge to give the appearance of the bands.

**Discussion.** The structure that we have proposed to explain the phenomenon of the bands of Fontana1, may contribute in understanding why a nerve-gap lesion can be successfully repaired even without providing any real topographical matching (a common clinical occurence when, for example, artificial nerve-guides are used). Brain plasticity may not be the only reason. Nerve fibers, spiralling at high pitch, will let any small group of them to evenly spread all around the circumference in a distance of few microns. This means that for any small bundle of fibers in the proximal stump, there will be always a high probability for at least some fiber to reach the correct target. After this has occurred, then brain plasticity will potentiate the effective connections while the wrong ones will fade.

1Merolli A, Mingarelli L, Rocchi L. A more detailed mechanism to explain the “bands of Fontana” in peripheral nerves. Muscle Nerve 2012 46(4):540-547