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Atlas of Cutaneous Branch Territories for the Diagnosis of Neuropathic Pain

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Foreword to The First Edition in English

The skin is defining of aesthetic appearance and while its features are of great importance to the practising clinician, its significance is often neglected by students. Once cut and peeled away during human anatomical dissection, the skin is disregarded as students trace the complicated and interesting pathways of major nerves and vessels and seek out different organs. Health sciences students may learn the functions of the skin in relation to its protection of the body from the external environment, prevention of loss of fluids, its immunological function, regulation of temperature and even mechanical support, but often do not appreciate or understand its importance in cutaneous innervation. This book is thus of great value to those health professionals who qualify as doctors, particularly surgeons, as well as physiotherapists and occupational therapists.

Why Is This So?

This detailed atlas maps the cutaneous sensory nerves of the human body as emanating from, not passing to, the skin areas from which they convey sensitivity. Instead of using dermatomes, the authors use "domains" to depict the territories from which the nerves emanate. In this way the atlas is unorthodox, as it differs from other atlases of anatomy. The cutaneous domain is defined as having a set of sensory nerve endings whose axons carry a common sensitivity. It includes several "autonomous" territories that each exclusively emit their fibres to the same nerve branch. Every territory is surrounded by skin areas which project to different branches of the same domain. There are ten pairs of domains that roughly correspond to one cranial nerve (trigeminal domain) and nine spinal segments. The mapping of the domains in a centripetal manner is of importance from a clinical perspective as neuropathic pain generally presents distally and advances proximally.

The "domains" described in this atlas can only be delineated in living subjects, rather than in unconscious immobile patients. Physical examination of over 3000 patients, in which the extension of the domains and their autonomous territories were measured, has been undertaken by aesthesiography and/or allodynography. Thus, the atlas is unique and indisputable.

While of unquestionable importance to those clinicians assessing neurological disorders, the book will also be of great interest to anatomists, since it presents a novel viewpoint of anatomical facts.

It is my great privilege to provide this foreword to the first English edition of the book, which is an updated and amended version of the third French version. The authors of the book, who are distinguished clinicians and anatomists, are to be congratulated on producing an evidence-based, concise presentation, which will be of great value to clinicians and anatomists alike.

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President of the International Federation of Associations of Anatomists

Foreword to the Second Edition (2013)

At the outset the authors make it clear that this atlas has a radically different viewpoint compared to other atlases of cutaneous nerve distribution. Specifically, they mapped cutaneous sensation from the periphery towards the centre. For the cutaneous distribution of any given nerve, they mapped the most distal extent first, then moved proximally mapping medial and lateral boundaries until they approached the most proximal limit. This makes clinical sense because sensory neuropathies typically present distally and progress proximally.

The clinical emphasis of the atlas is also obvious because it is based on maps obtained from over two thousand neuropathic pain patients (NPP), nearly double the number of patients mapped for the first edition of this atlas. This large sample of NPPs was validated by the contributions of several distinguished collaborators from around the world. There are also about a hundred clinical anatomy references. The astute observer will note variations in the maps of many of these references with each other and with this atlas. This is because the cutaneous distribution of sensory nerves varies among patients. To make this atlas valuable even though these distributions vary, the authors have chosen to illustrate the "largest territory of cutaneous distribution of the nerves." Therefore, in a given patient, the distribution of a cutaneous nerve can be expected to fall within the boundaries outlined in this atlas. These maps cannot be precise, but at least the outer margins are given and this will be of value to the practitioner who sees these patients.

In addition to the territory of innervation, maps for different sensations are also presented. For example, pain is perceived at lower thresholds than touch so the territory for pain sensation will typically be larger. This is due to the facts that receptors with different stimulus modalities are involved in receiving these sensations and different fibres conduct the impulses. In spite of these differences, touch (as defined by detection of a 0.7 g weight applied to the skin) is diminished in the same territory where pain is perceived.

Although the maps for all territories of the body are clearly designed, one of the most useful features of this atlas is the summary of the maps of the intercostal nerves. This provides the clinician with an image that is easy to grasp and apply to numerous clinical situations. Also, many of the drawn maps are supplemented with photographs that make the distribution of the cutaneous nerves quite unambiguous. Furthermore, some judiciously chosen tables provide valuable references for busy clinicians. Finally, indexes of the anatomical territories and the tables at the end of the atlas provide a ready guide to any cutaneous nerve of interest.

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Glossary

Taking into account, as much as possible, taxonomies developed by international organisations for anatomy and pain (Federative Committee on Anatomical Terminology 1998; Loeser & IASP Taxonomy Working Group 2011).

Aesthesiography: clinical examination sign of tactile hypoaesthesia obtained from the mapping of a cutaneous territory where a determined mechanical application force is *NOT* detected.

Aesthesiometer: instrument used to measure the importance of tactile hypoaesthesia by bending a nylon filament, often termed monofilament.

Allodynography: clinical examination sign of static mechanical allodynia obtained from the mapping of a cutaneous territory where a standardised mechanical stimulation provokes a pain of 3 cm on a Visual Analogue Scale (VAS).

***Autonomous* territory of cutaneous origin**: exclusive territory innervated by only one cutaneous nerve branch.

Axiom: element from which knowledge is deducted following logical rules – Εὐκλείδης [Euclid] – Third Century before J.-C. – *Elements of Geometry*.

Clinical anamnesis: term designating the questioning of the patient in order to precisely collect the different evocations of his pain symptoms – from old Greek Ἀνάμνησις [anamnêsis]. It is a crucial moment in the somatosensory therapist of pain's reasoning, and it is performed by means of the McGill Pain Questionnaire. It demands a good knowledge of clinical anatomy, especially of the territorial origin of every cutaneous branch. It is *neither* a self-report questionnaire *nor* a medical history.

Cutaneous domain: set of cutaneous territories which have their origin in the different nervous branches involved in the same clinical setting, i.e. symptomatic trigeminal neuralgia. The skin is subdivided into ten cutaneous domains.

Diagnostic testing of Aβ axonal lesions: panel of four very sensitive tests to diagnose tactile sense disorders.

***Distant* vibrotactile counter-stimulation**: technique that uses a comfortable tactile or vibratory agent at *distance* in order to allow the patient to perceive the stimulus in a comfortable manner. The skin portion to be stimulated is defined jointly by the patient and by the somatosensory therapist of pain.

***Largest* territory of cutaneous origin**: is thus the territory of a cutaneous branch delimited by the four cardinal points furthest from the autonomous territory.

Mechanical allodynia: pain due to a mechanical stimulus which does not normally provoke pain.

Neuralgia: painful condition resulting from spontaneous firing of a nerve following Aβ, Aδ and/or C axonal lesions.

Neuropathic pain: pain caused by a lesion or disease of the somatosensory nervous system.

Receptor field: range of activity on the skin of one neurofibre and its somatosensory primary neuron.

Secondary aesthesiography: clinical examination sign of underlying tactile hypoaesthesia obtained from the mapping of a cutaneous territory where a determined mechanical application force is *NOT* detected the day when the allodynography becomes negative.

Tactile hypoaesthesia: reduced perception of touch.

Tactile sense: capacity of the cutaneous mechanoreceptors to detect tactile stimuli.

Territory of cutaneous origin: set of receptor fields innervated by ascendant Aβ neurofibres of a cutaneous nerve branch.

Underlying hypoaesthesia: tactile hypoaesthesia masked by a mechanical allodynia and revealed after its disappearance.

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Part I