

---

Pain – Its Neurosurgical Management  
Part I: Procedures on Primary Afferent Neurons

---

# Progress in Neurological Surgery

Vol. 7

**Series Editors**

H. KRAYENBÜHL, Zurich; P.E. MASPES, Milan; W.H. SWEET, Boston, Mass.

**Assistant Editors**

P. PAOLETTI, Pavia; Ch.E. POLETTI, Boston, Mass.

**Advisory Board**

R. ARANA-INGUÉZ, Montevideo; M. DAVID, Paris; J. GILLINGHAM, Edinburgh;  
S. OBRADOR, Madrid; J.L. POOL, New York, N.Y.; T. RIECHERT, Freiburg i. Br.;  
K. SANO, Tokyo; A.E. WALKER, Baltimore, Md.



---

S. Karger · Basel · München · Paris · London · New York · Sydney

---

# Pain – Its Neurosurgical Management

## Part I: Procedures on Primary Afferent Neurons

### List of Contributors

M. CHOPPY, Paris; G. FISCHER, Lyon; P. J. JANETTA, Pittsburgh, Pa;  
J. LE BEAU, Paris; D. M. LONG, Baltimore, Md; B. LYNN, London;  
L. MANSUY, Lyon; I. PAPO, Ancona; M. SINDOU, Lyon; W. H. SWEET,  
Boston, Mass; A. VISCA, Pietra Ligure; J. C. WHITE, Boston, Mass.

45 figures and 16 tables, 1976



---

S. Karger · Basel · München · Paris · London · New York · Sydney

---

## Progress in Neurological Surgery

Vol.1: VIII+308 p., 142 fig., 28 tab., 1966. ISBN 3-8055-0410-1  
Vol.2: X+406 p., 141 fig., 31 tab., 1968. ISBN 3-8055-0412-8  
Vol.3: XIV+440 p., 139 fig., 28 tab., 1969. ISBN 3-8055-0413-6  
Vol.4: XIV+498 p., 280 fig., 31 tab., 4 diagr., 1971. ISBN 3-8055-1166-3  
Vol.5: XIV+438 p., 124 fig., 22 tab., 1973. ISBN 3-8055-1499-9  
Vol.6: XVI+490 p., 157 fig., 54 tab., 1975. ISBN 3-8055-2101-4

---

### Cataloging in Publication

Pain: its neurosurgical management

List of contributors, M. Choppy [et al.]. Basel, New York, Karger, 1976.

(Progress in neurological surgery, v. 7)

Contents: Procedures on primary afferent neurons.

1. Pain – surgery 2. Neurosurgery I. Choppy, M. II. Title III. Series

W1 PR673 v. 7/WL 700 P1465

ISBN 3-8055-2317-3

---

All rights, including that of translation into other languages, reserved.

Photomechanic reproduction (photocopy, microcopy) of this book or parts thereof without special permission of the publishers is prohibited.

- © Copyright 1976 by S.Karger AG, Basel (Switzerland), Arnold-Böcklin-Strasse 25  
Printed in Switzerland by F. Pochon-Jent AG, Berne  
ISBN 3-8055-2317-3

## Contents

### Part I Pain—Its Neurosurgical Management

#### *Procedures on Primary Afferent Neurons*

<i>Physiology of the Activation of Pain</i> LYNN, B., London .....	1
I. Introduction .....	2
II. Peripheral Receptor Units .....	3
A. Afferent Fibres Responding only to Noxious Stimulation of the Skin .....	3
1. Nociceptor Units with Myelinated Axons .....	3
2. Nociceptor Units with Unmyelinated Axons .....	5
B. Afferent Fibres Responding Distinctively to Noxious and Non-Noxious Cutaneous Stimuli .....	7
C. Afferent Fibres responding to Noxious Stimulation of Non-Cutaneous Tissues .....	8
1. Immediately Subcutaneous Structures .....	8
2. Skeletal Muscle .....	8
3. Heart Muscle .....	9
4. Smooth Muscle .....	9
5. Joints .....	10
6. Mucous Membranes .....	10
7. Connective Tissue and Blood Vessels of the Viscera .....	10
8. Tooth Pulp; Testis; Cornea .....	11
D. Synopsis of Sections A–C .....	11
E. Long-Term Increases in Nociceptor Excitability .....	12
III. Synaptic Connections of Nociceptor Afferents .....	14
A. ‘Specific’ Nociceptor Cells .....	15

<b>Contents</b>	<b>VI</b>
1. Marginal Cells.....	15
2. Other Locations of Specific Cells .....	17
B. Units Responding Distinctively to Noxious and Non-Noxious Stimuli....	17
IV. Neurones Projecting to Higher Centres .....	19
A. Crossed Spinoreticular and Spinothalamic Tracts .....	19
B. Polysynaptic Pathways .....	22
C. Dorsal Tracts Running to the Dorsal Column and Spinocervical Nuclei...	22
1. Spinocervical Tract (SCT) .....	23
2. Post-Synaptic Fibres to the Dorsal Column Nuclei .....	24
D. Discussion: Spinal Cord Projection Paths .....	25
V. Concluding Remarks .....	25
VI. Acknowledgement .....	27
VII. References .....	27
 <i>Cutaneous Afferent Stimulation for the Relief of Pain</i>	
LONG, D. M., Baltimore, Md. ....	35
The Experience .....	41
The Patient Population .....	41
Use of Stimulator .....	42
Results .....	43
Late Follow-Up .....	44
Complications .....	46
Discussion .....	47
Summary .....	49
References .....	50
 <i>On the Importance of Psychological Testing in the Medical or Surgical Treatment of Pain</i>	
LE BEAU, J. and CHOPPY, M., Paris .....	52
Patients and Methods .....	52
Patients.....	52
Psychological Examination .....	52
Results .....	53
Comments .....	54
Conclusions and Summary .....	54
References .....	55
 <i>Intrathecal Phenol in the Treatment of Pain and Spasticity</i>	
PAPO, I., Ancona and VISCA, A., Pietra Ligure .....	56
Introduction .....	57
Pathology .....	59

Contents	VII
Pathology of Intrathecal Phenol in Man .....	59
Pathology of Intrathecal Phenol in Laboratory Animals .....	66
Mode of Action .....	71
Solutions Used .....	73
Technique and Dosage .....	74
Effects of Intrathecal Injection of Phenol .....	78
CSF Changes .....	78
Effects on the Nervous Structures .....	78
Therapeutic Effects .....	79
Sensory Changes .....	79
Motor Changes .....	82
Reflex Changes .....	83
Alterations of Bladder and Rectal Function.....	83
Alterations of Autonomic Functions .....	85
Clinical Results .....	86
Duration of the Therapeutic Effect .....	86
Clinical Results in Cancer Pain .....	87
Personal Case Series.....	90
Clinical Results in Nonneoplastic Diseases .....	95
Personal Case Series .....	98
Factors Governing the Results of Treatment.....	102
Indications .....	106
Concluding Remarks .....	108
Intrathecal Phenol in the Treatment of Spasticity .....	110
Material and Methods .....	111
Results .....	112
Global Results .....	113
Effects on Individual Components of the Syndrome .....	115
Duration of Results .....	118
Extrathecal Phenol .....	118
Discussion and Conclusions .....	119
References .....	123
 <i>Role of Sympathectomy in Relief of Pain</i>	
WHITE, J. C., Boston, Mass. ....	131
I. Visceral Pain .....	131
A. Anatomy and Physiology of Visceral Sensory Innervation .....	131
B. Application of Sympathectomy to Relief of Visceral Pain .....	136
II. Causalgia and Allied Conditions .....	144
A. Causalgia of WEIR MITCHELL .....	144
B. Causalgia-Like Conditions .....	145
III. Conclusions .....	146
IV. References .....	146

Contents	VIII
<i>Treatment of Facial Pain by Percutaneous Differential Thermal Trigeminal Rhizotomy</i>	
SWEET, W.H., Boston, Mass. ....	153
I. Introduction .....	154
A. Technical Ingredients for Success .....	155
II. Clinical Material and General Results .....	156
III. Details of Surgical Technique .....	158
A. Wrong Foramina Entry .....	159
B. Arterial Puncture .....	164
C. Final Electrode Placement .....	165
D. Avoidance of Corneal Anesthesia .....	167
IV. Early Failures .....	168
V. Intraoperative Complications .....	168
VI. Postoperative Complications and Deficits .....	169
A. Aseptic Meningeal Reaction .....	169
B. Dysphagia .....	169
C. Late Infection .....	169
D. Masticator Weakness or Paralysis .....	170
E. Disagreeable Sensations Related to Sensory Loss .....	170
F. Other Minor Sequelae .....	171
VII. Avoidance of Dysesthesias .....	172
A. Retrogasserian Differential Lidocaine Block .....	172
B. Patient's Appraisal of His Sensations as Lesion Evolves.....	175
VIII. Preservation of Some Touch .....	175
IX. Results Concerning Pain .....	176
A. Trigeminal Neuralgia .....	176
B. Multiple Sclerosis .....	177
C. Other Types of Facial Pain .....	177
X. Conclusions .....	177
XI. References .....	178
 <i>Microsurgical Approach to the Trigeminal Nerve for Tic Douloureux</i>	
JANNETTA, P.J., Pittsburgh, Pa. ....	180
The Anatomy of the Trigeminal Nerve Roots .....	181
The Relationships of the Trigeminal Nerve in the Posterior Fossa .....	183
Review of Evidence Regarding the Etiology of Tic Douloureux .....	185
The Evidence for Abnormality of the Trigeminal Nerve-Root Entry Zone as the Cause of Tic Douloureux .....	187
Preoperative Evaluation of a Patient with Tic Douloureux .....	190
Indications for Operation .....	192
Operative Technique .....	192
Postoperative Course and Operative Results .....	197
Summary .....	198
References .....	199

<b>Contents</b>	<b>IX</b>
<i>Posterior Spinal Rhizotomy and Selective Posterior Rhizidiotomy</i>	
SINDOU, M.; FISCHER, G., and MANSUY, L., Lyon (France) .....	201
<b>Introduction .....</b>	<b>202</b>
<b>Part I: Posterior Spinal Rhizotomy .....</b>	<b>203</b>
<b>I. Main Indications .....</b>	<b>203</b>
<b>1. Painful Cancerous Diseases .....</b>	<b>203</b>
Cervical and Cervicofacial Cancers .....	203
Cervicothoracic Cancers .....	207
Cancers of the Trunk .....	208
Pelvic Cancers .....	208
<b>2. Painful Noncancerous Diseases .....</b>	<b>210</b>
Cervico-Occipital Pain.....	210
Arm Pain .....	211
Trunk Pain .....	215
Leg Pain .....	216
Perineococcygeal Pain .....	218
Visceral Pain .....	220
a. Angina Pectoris .....	221
b. Pain from Aortic Aneurysm .....	221
c. Pain in the Digestive System .....	221
d. Pain in the Kidneys .....	221
<b>3. Risks and Limits of Posterior Rhizotomy .....</b>	<b>222</b>
<b>II. Prognostic Factors and Causes of Failure .....</b>	<b>223</b>
<b>1. Prognostic Factors .....</b>	<b>223</b>
<b>2. Causes of Failure .....</b>	<b>225</b>
<b>III. Technical Progress .....</b>	<b>227</b>
<b>1. Verification of the Level of the Laminectomy .....</b>	<b>227</b>
<b>2. Root Identification.....</b>	<b>228</b>
<b>3. Selection of Roots .....</b>	<b>228</b>
<b>4. Contributions of Microsurgical Techniques.....</b>	<b>228</b>
<b>Part II: An Attempt to Develop a Selective Radicular Surgery: Selective Posterior Rhizidiotomy.....</b>	<b>229</b>
<b>I. The Anatomy of the Posterior Spinal Cord Rootlet Junction .....</b>	<b>230</b>
<b>1. Microscopic Anatomy .....</b>	<b>230</b>
The Posterior Rootlet Entity .....	230
Fiber Organization.....	231
<b>2. Vascularization .....</b>	<b>234</b>
<b>3. Mesoscopic Anatomy .....</b>	<b>236</b>
<b>II. Method of the Selective Posterior Rhizidiotomy.....</b>	<b>239</b>
<b>1. General Technique .....</b>	<b>239</b>
<b>2. Peroperative Identification of the Roots .....</b>	<b>240</b>
<b>3. Root Choice .....</b>	<b>241</b>
<b>III. Preliminary Results .....</b>	<b>241</b>
<b>1. Pain from Malignant Diseases .....</b>	<b>241</b>
Results on Pain .....	242
Side Effects .....	242

Contents	X
2. Painful Spastic Syndromes .....	242
IV. Indications .....	244
V. Discussion .....	244
Conclusion .....	245
References .....	246
 Subject Index .....	 251
Author Index .....	259

## Part II: Vol. 8 of the series Pain – Its Neurosurgical Management

### *Central Procedures*

TASKER, R. R. (Toronto, Ont.): Open Cordotomy .....	1
ŠOUREK, K. (Prague): Mediolongitudinal Myelotomy .....	15
NASHOLD, B. S., jr.; SLAUGHTER, D. G.; WILSON, W. P., and ZORUB, D. (Durham, N.C.): Stereotactic Mesencephalotomy .....	35
SANO, K. (Tokyo): Intralaminar Thalamotomy (Thalamolaminotomy) and Postero-Medial Hypothalamotomy in the Treatment of Intractable Pain .....	50
SIEGFRIED, J. (Zürich): Stereotactic Pulvinarotomy in the Treatment of Intractable Pain .....	104
HITCHCOCK, E. (Edinburgh): Small Frontal Lesions for Intractable Pain .....	114
PAGNI, C.A. (Milan): Central Pain and Painful Anesthesia: Pathophysiology and Treatment of Sensory Deprivation Syndromes Due to Central and Peripheral Nervous System Lesions .....	132
SWEET, W.H. (Boston, Mass.): Intracranial Electrical Stimulation for Relief of Chronic Intractable Pain .....	258

### Subject- and Author Index