

Zusammenfassende Anatomie und Neuroanatomie obere HWS

Dr. med. U. W. Böhni

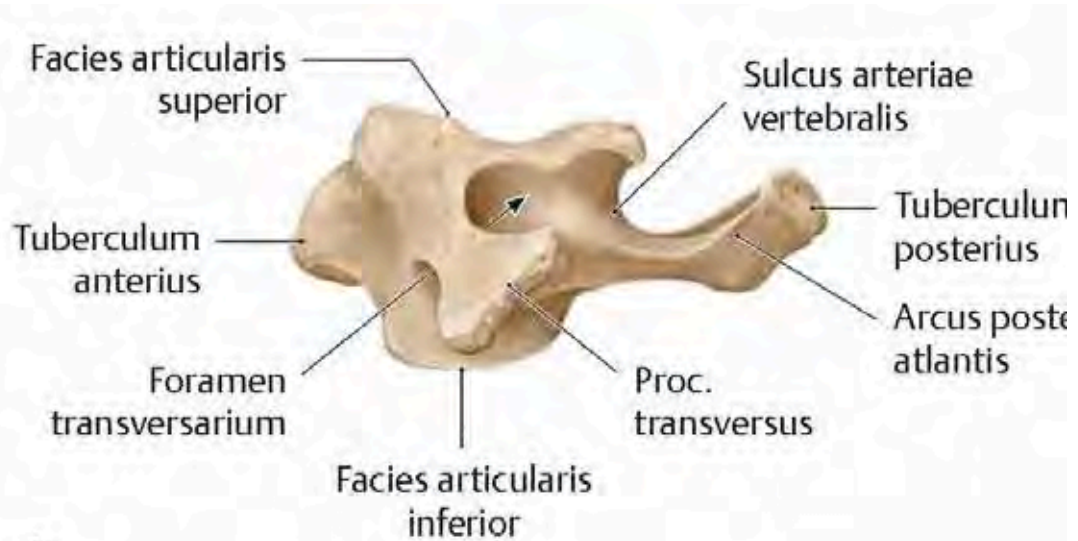
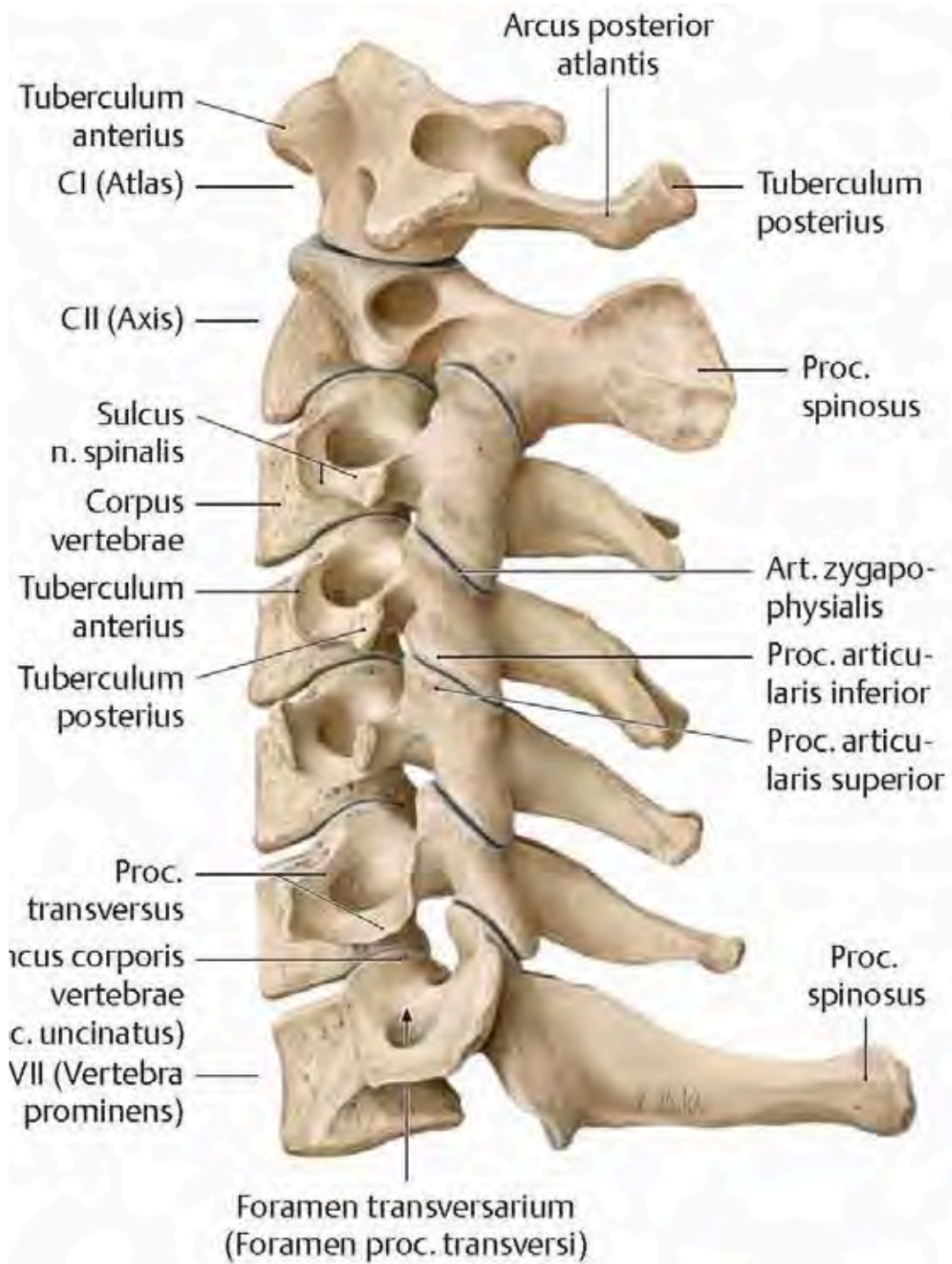
**Zentrum für interdisziplinäre Therapie
des Bewegungsapparates ZeniT**

SCHAFFHAUSEN (SCHWEIZ)

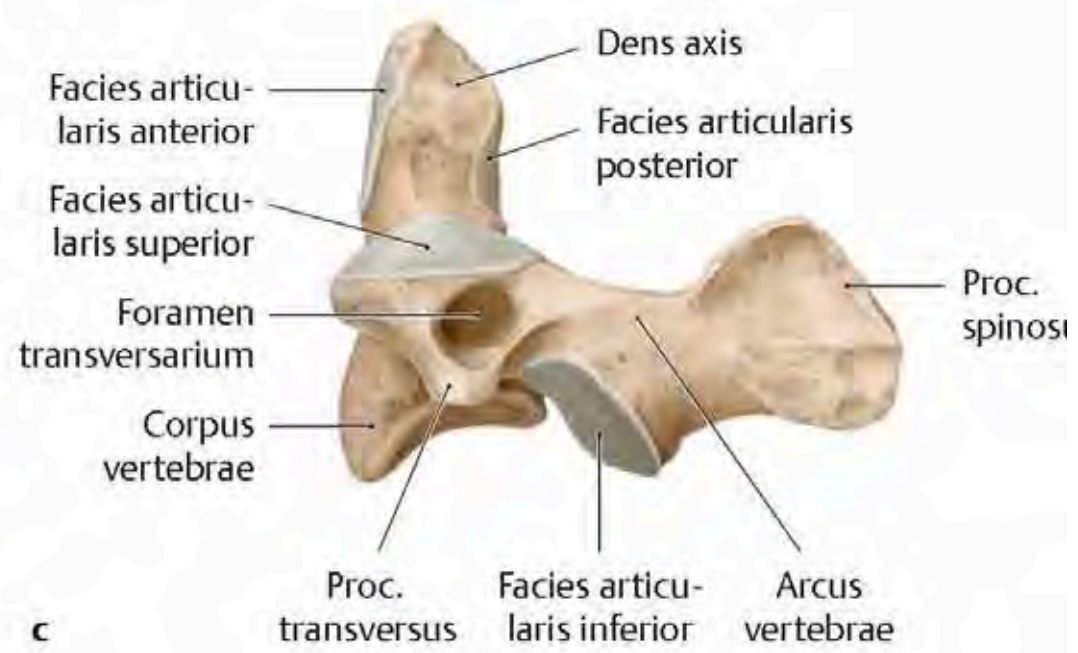
2023

2 Beschwerdesyndrome an der HWS: neuroanatomisch begründet

- Das **obere** zervikogene Schmerz- und Beschwerdesyndrom
 - Noziafferenzen C1-C3 – Segmente C0/1-C2/3 (C3/4)
 - Zervikozepale Symptome
 - Konvergenz mit trigeminalen und weiteren Hirnnervenafferenzen (zervikotrigeminale Konvergenz)
- Das **untere** zervikogene Schmerz- und Beschwerdesyndrom
 - Noziafferenzen C4-Th1
 - Einbezug zervikothorakaler Übergang
 - Nacken-Schulter-Arm-Beschwerden



b



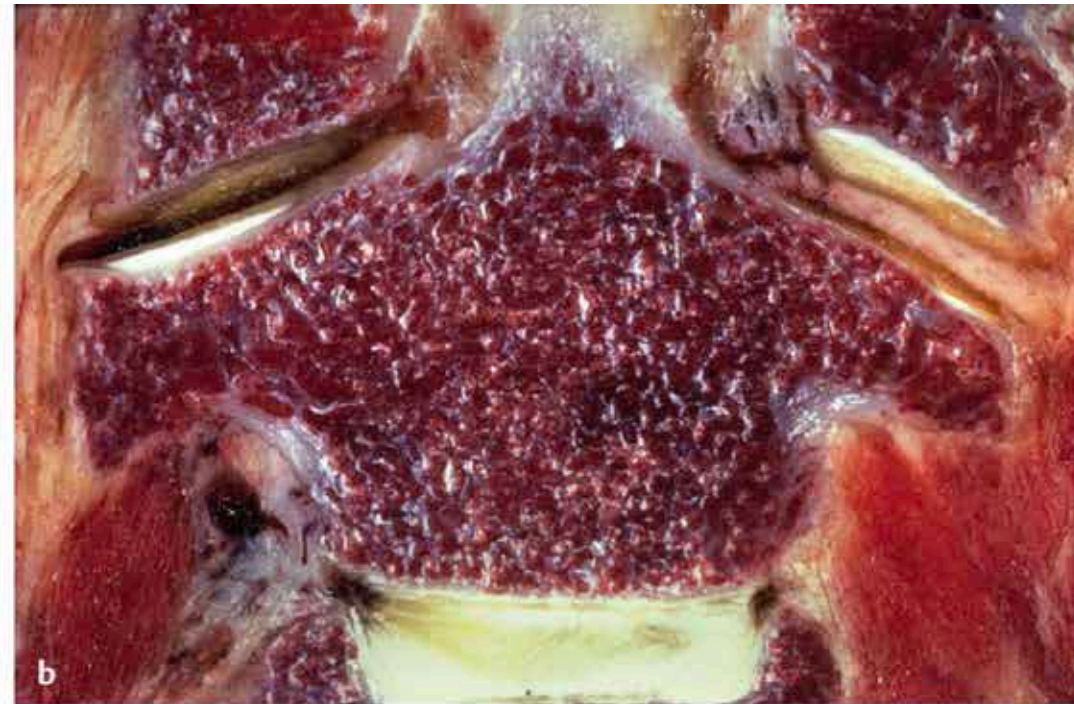
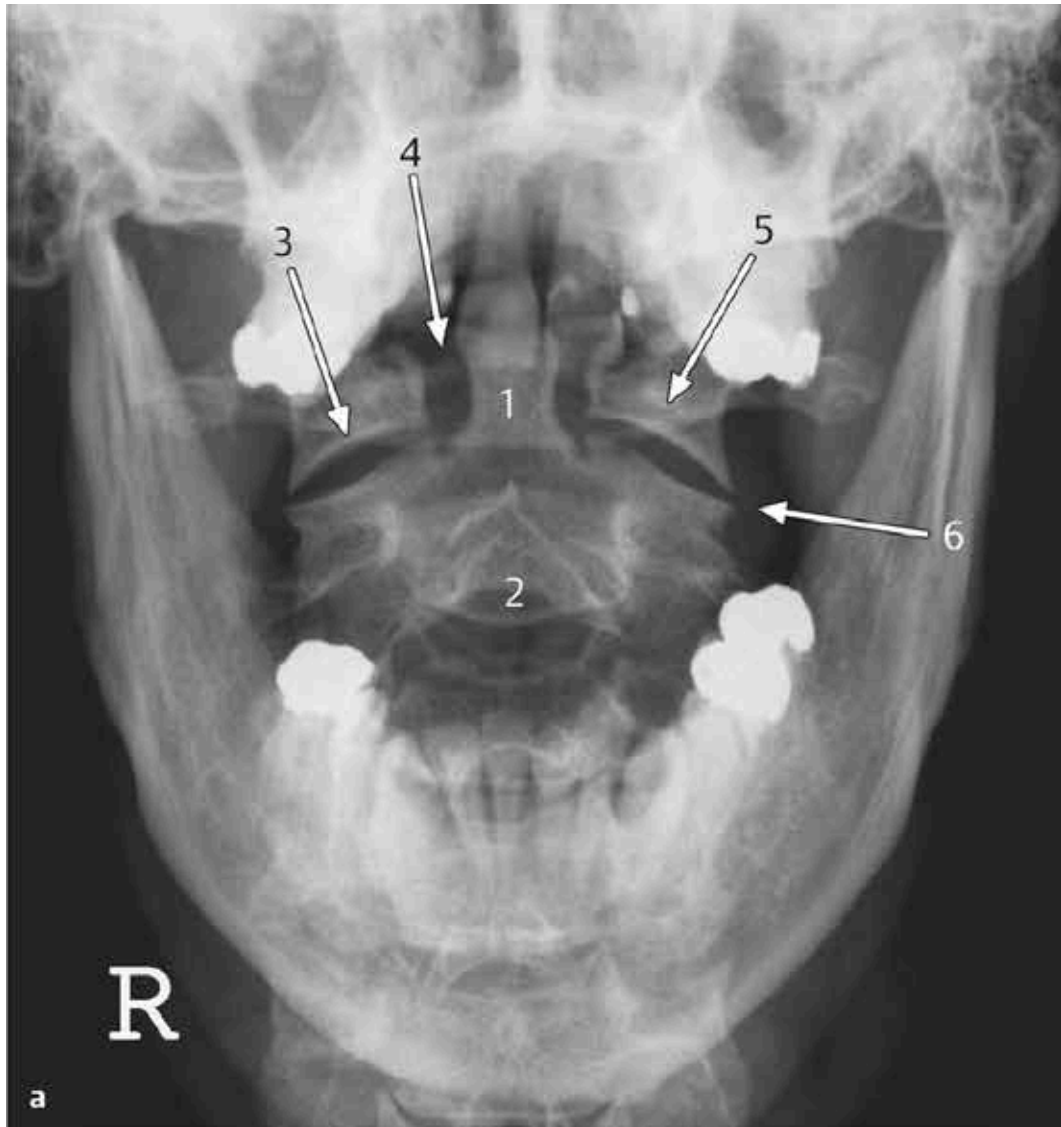
c

Atlas / Axis

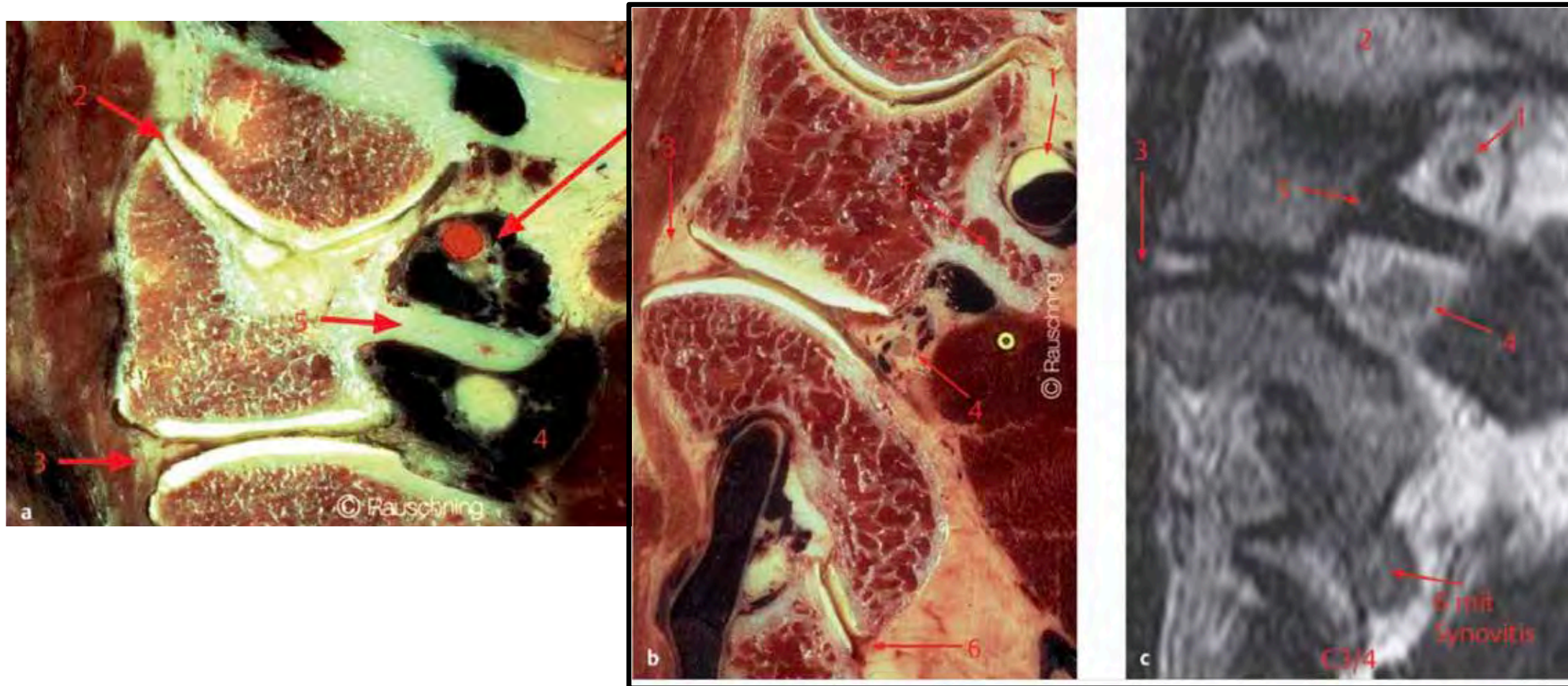


von vorne

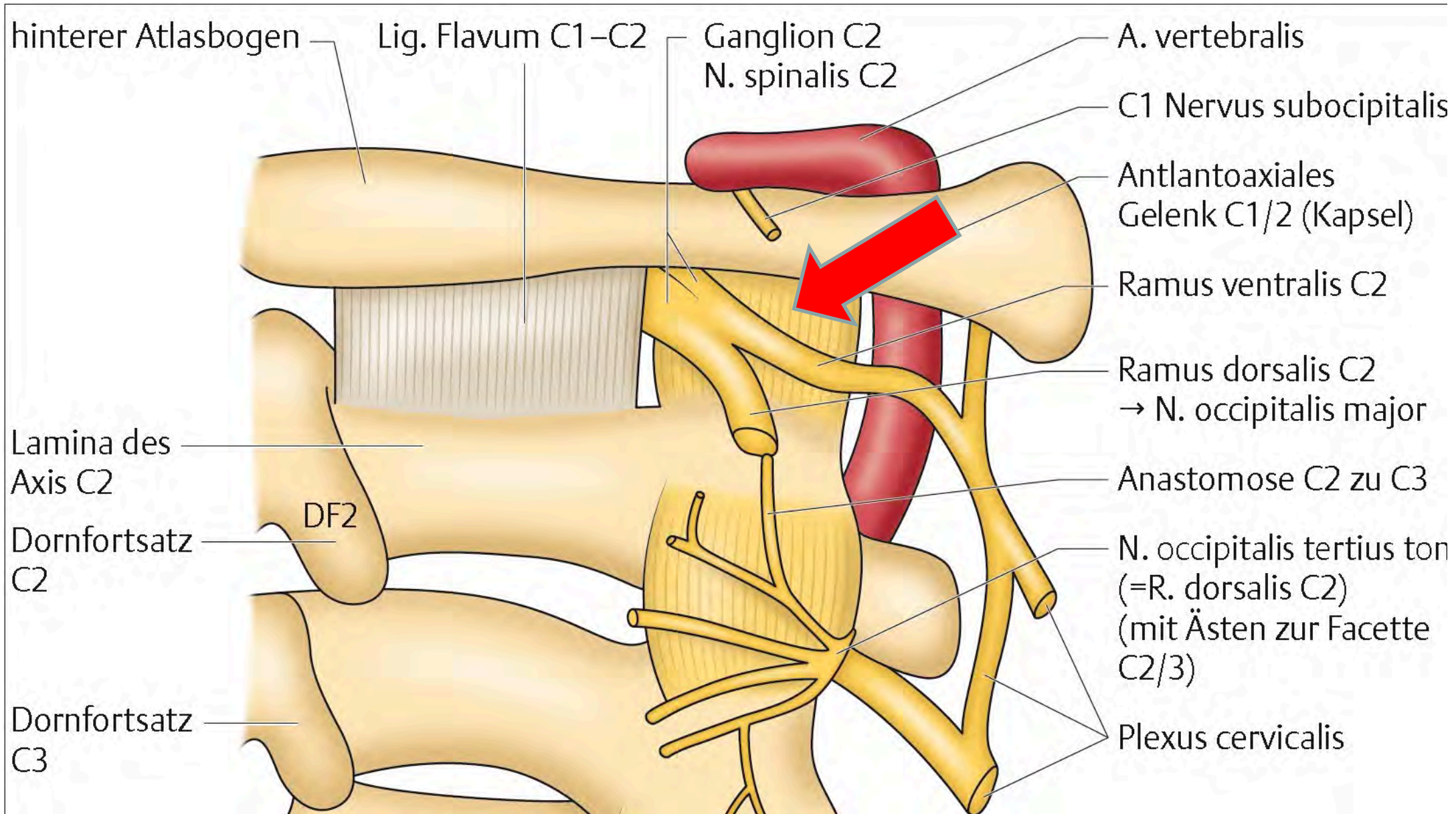
C1/2 Gelenke

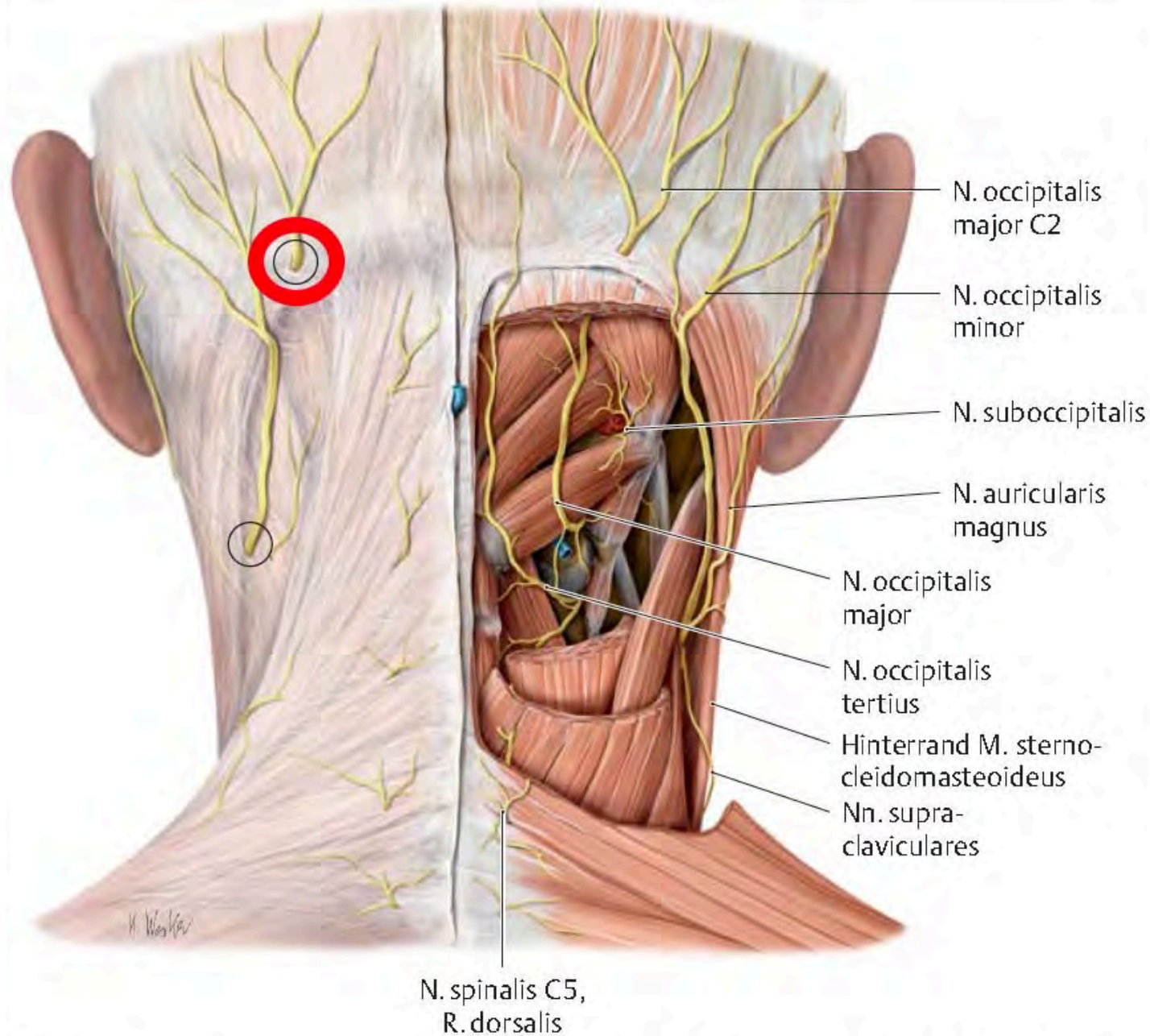


C1/2 paramedian dargestellt



N. occipitalis major / Ggl. C2 liegt neben Kapsel C1/2





○ klinisch wichtige Nervenaustrittsstellen: N. occipitalis major, N. occipitalis minor bzw. sensible Äste der Radix sensoria des Plexus cervicalis („Erb-Punkt“)

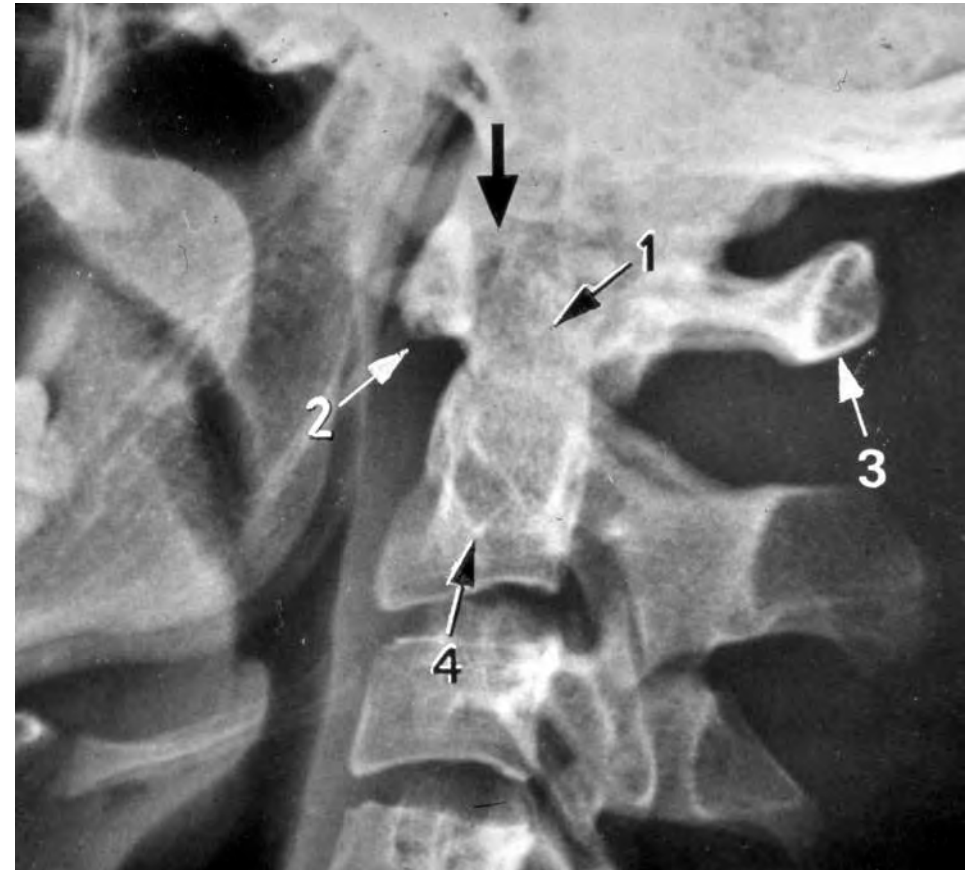
Aus © Böhni et al MM
Band 1 2022

Obere HWS Rö-seitlich

1. Dens axis
2. Vorderer Atlasbogen
3. Hinterer Atlasbogen
4. Corpus axis

Spezielle Kriterien:

- Dens abgesetzt?
(*Fraktur? Os odontoideum?*)
- *Atlanto-dentaler Abstand*
- *ossäre Struktur*
- *C2/3*

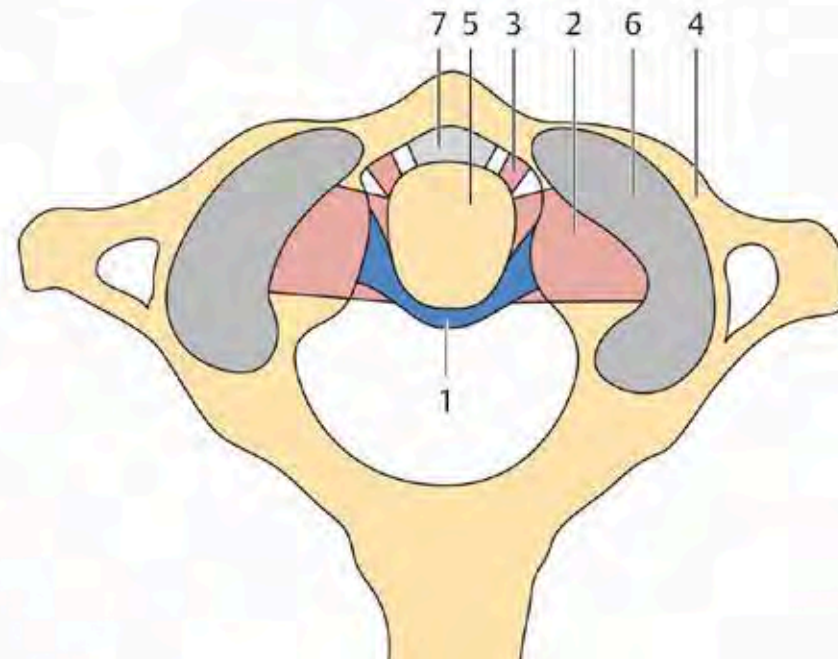
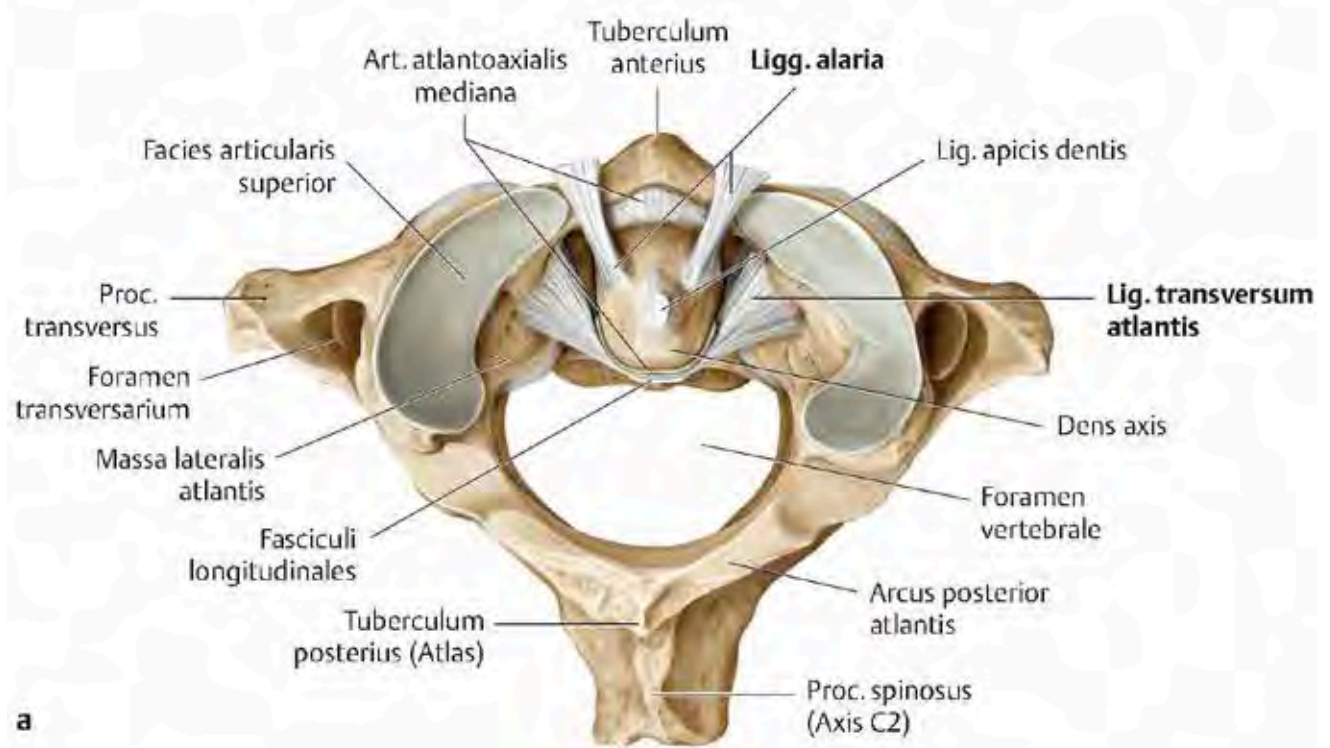


Bänder obere HWS

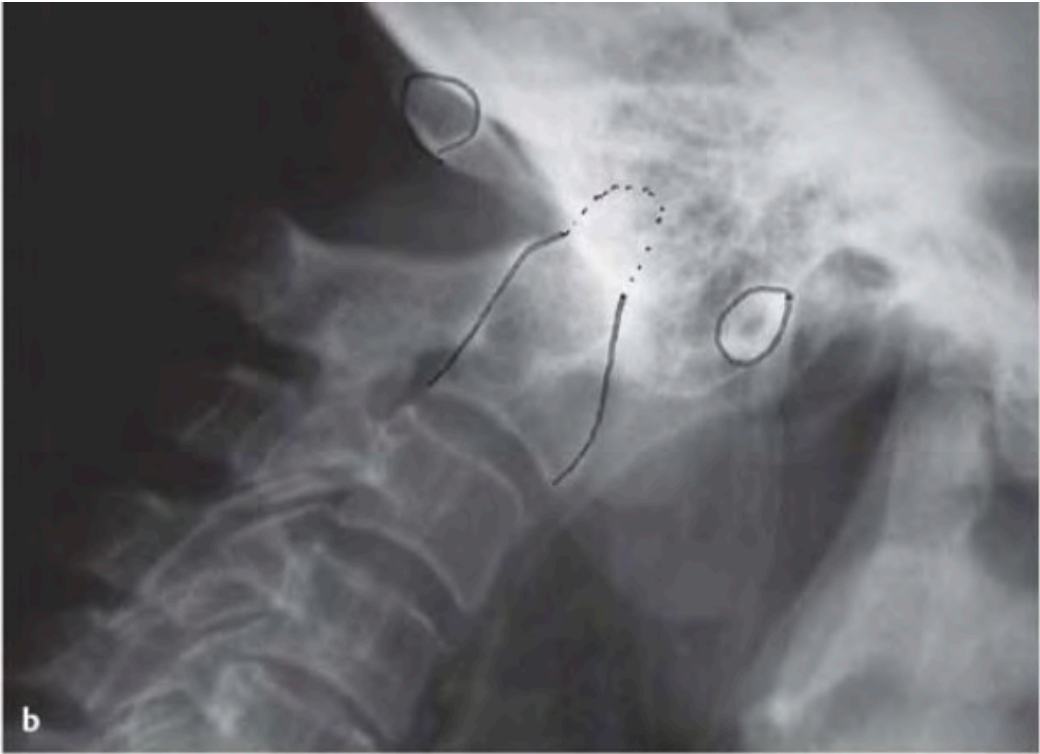
2 wichtig:

Ligg. alaria

Lig. transversum



Lig. transversum atlantis



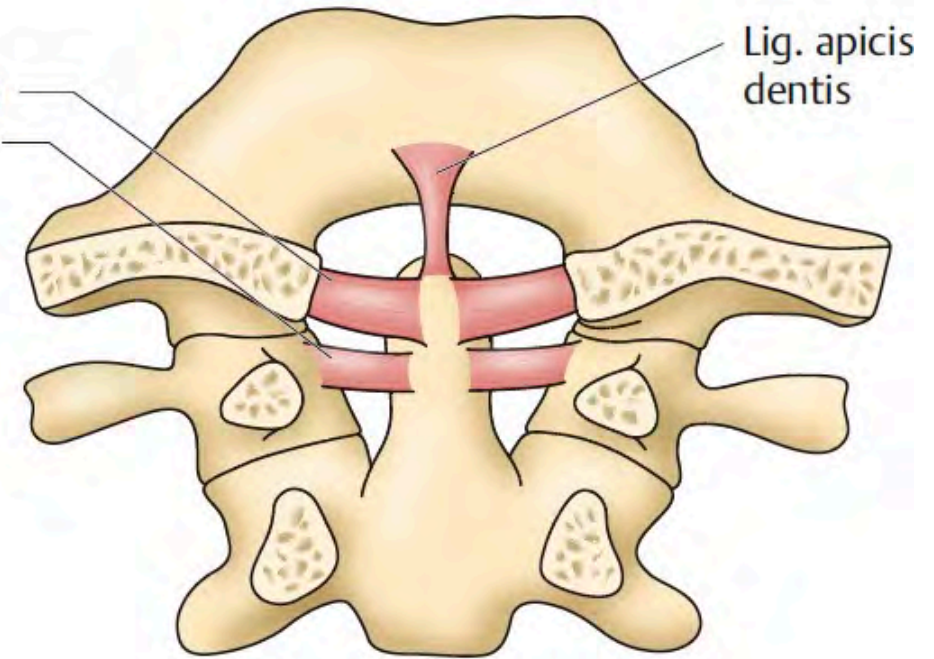
atlantodentale Instabilität

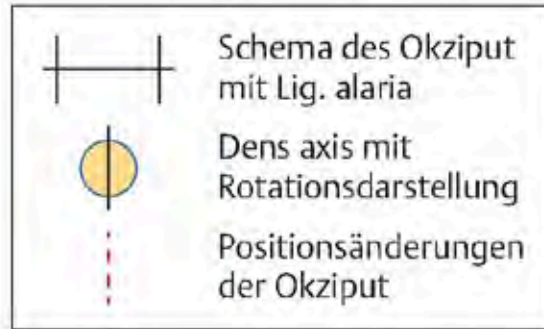
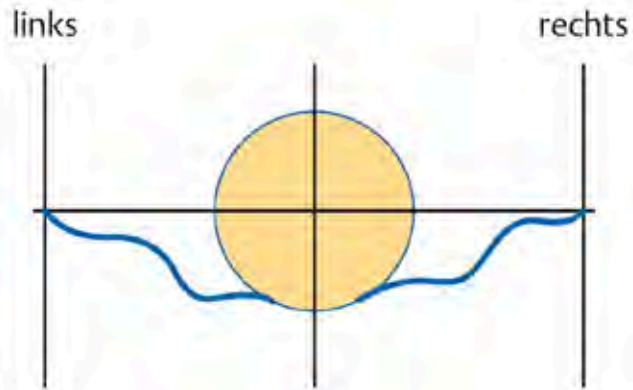


Ligg. alaria



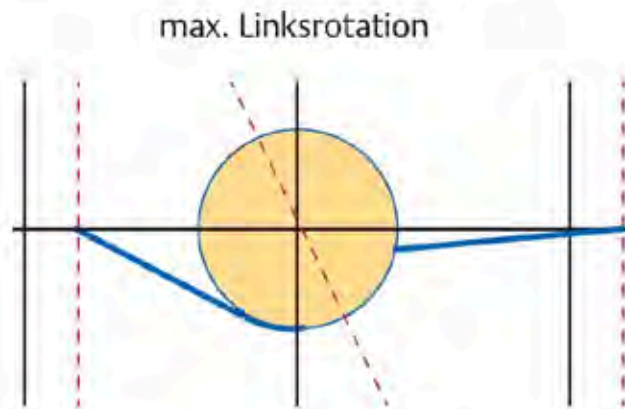
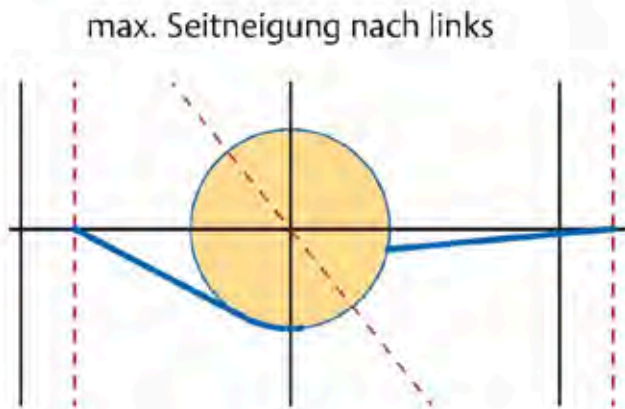
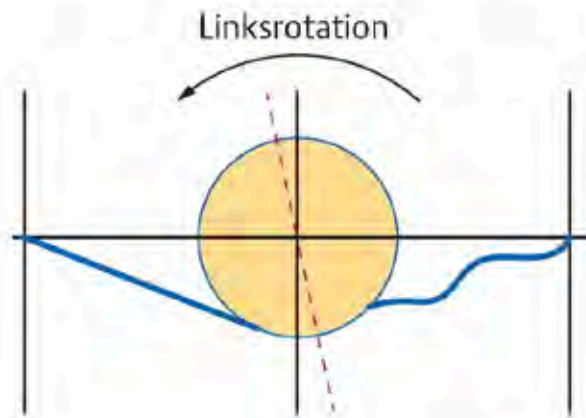
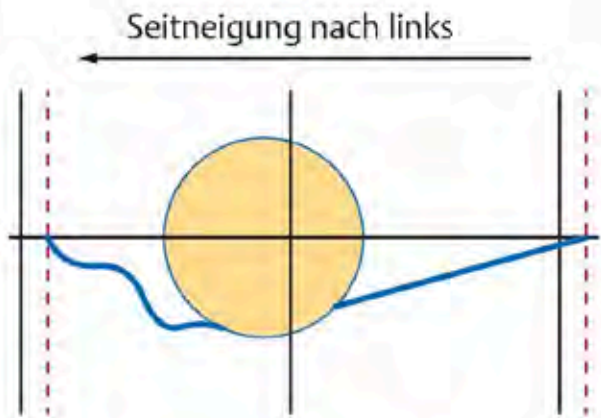
Lig. alare:
- okzipitale Portion
- atlantale Portion
(*inkonstant*)





Funktion Ligg. alaria

Nach Werne 1957,
Dvorak 1999
aus
MM Band 1 Abb. 5.10



max. Seitneigung nach links

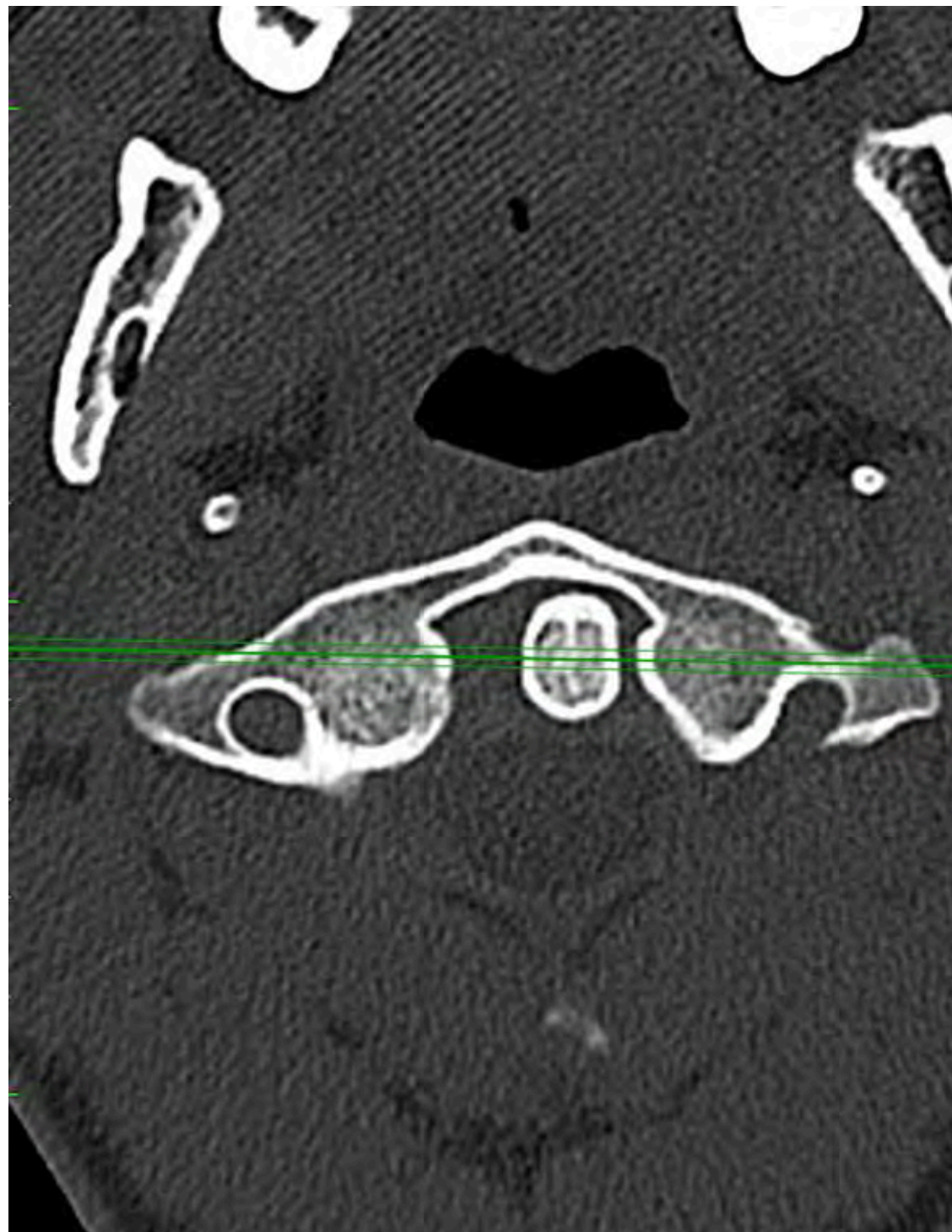
Rotation des Axis nach links

max. Linksrotation

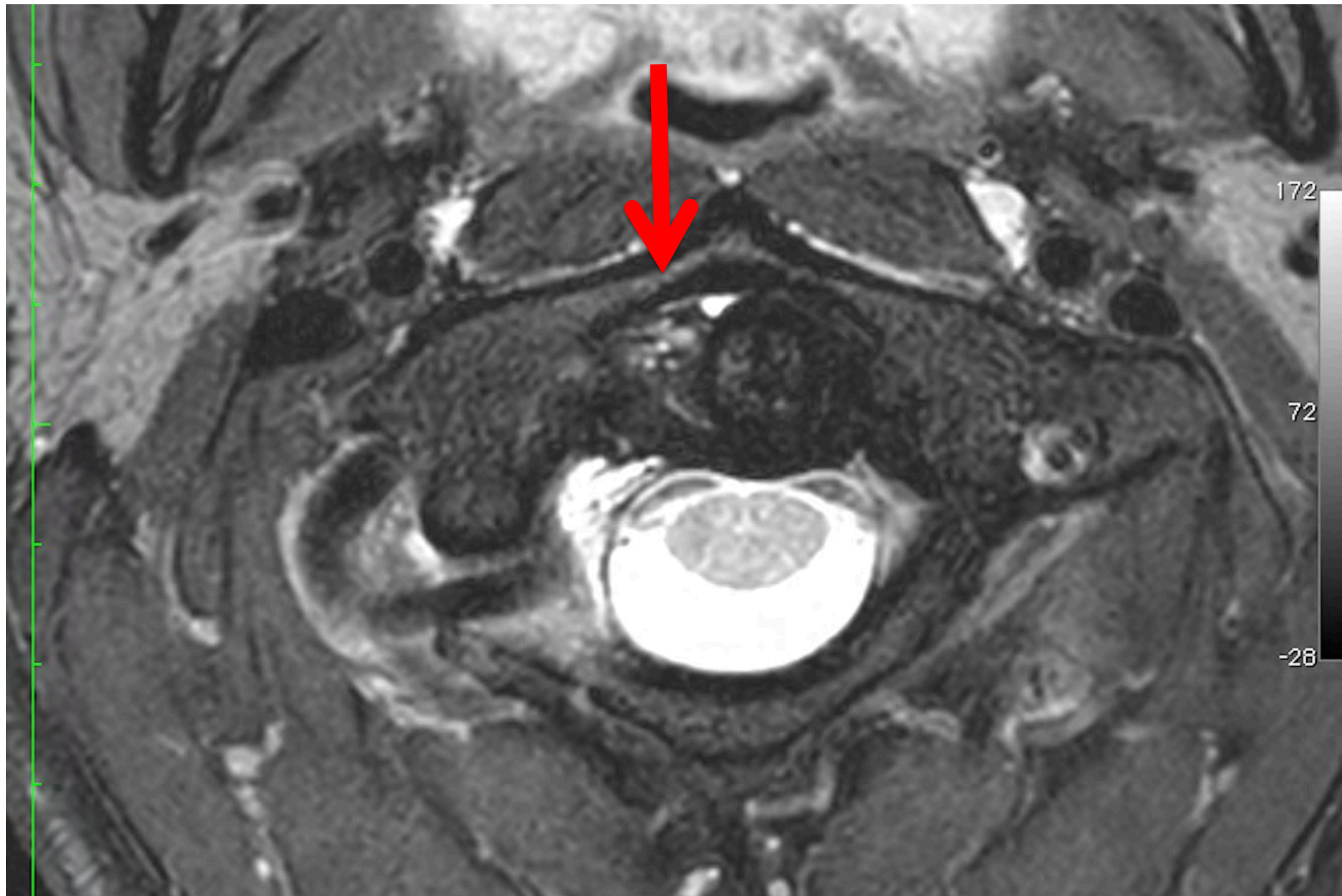
Zwangsneigung des Kopfes und Axis

M, 18-jährig

- Sturz mit 125ccm-Motorrad (geringe Geschwindigkeit)
- → Kontusion mit Kopf (Helm) gegen eine Baum
- Ganz-Körper CT als „screening“ → „negativ“
- Konsultation 3 Wochen später wegen persistierendem Schwindel und einseitigen Kopfschmerzen
- Massiv schmerzhafteste Rotationseinschränkung C1/2 betont links







C1/2 Rotation Computertomografie: 43°

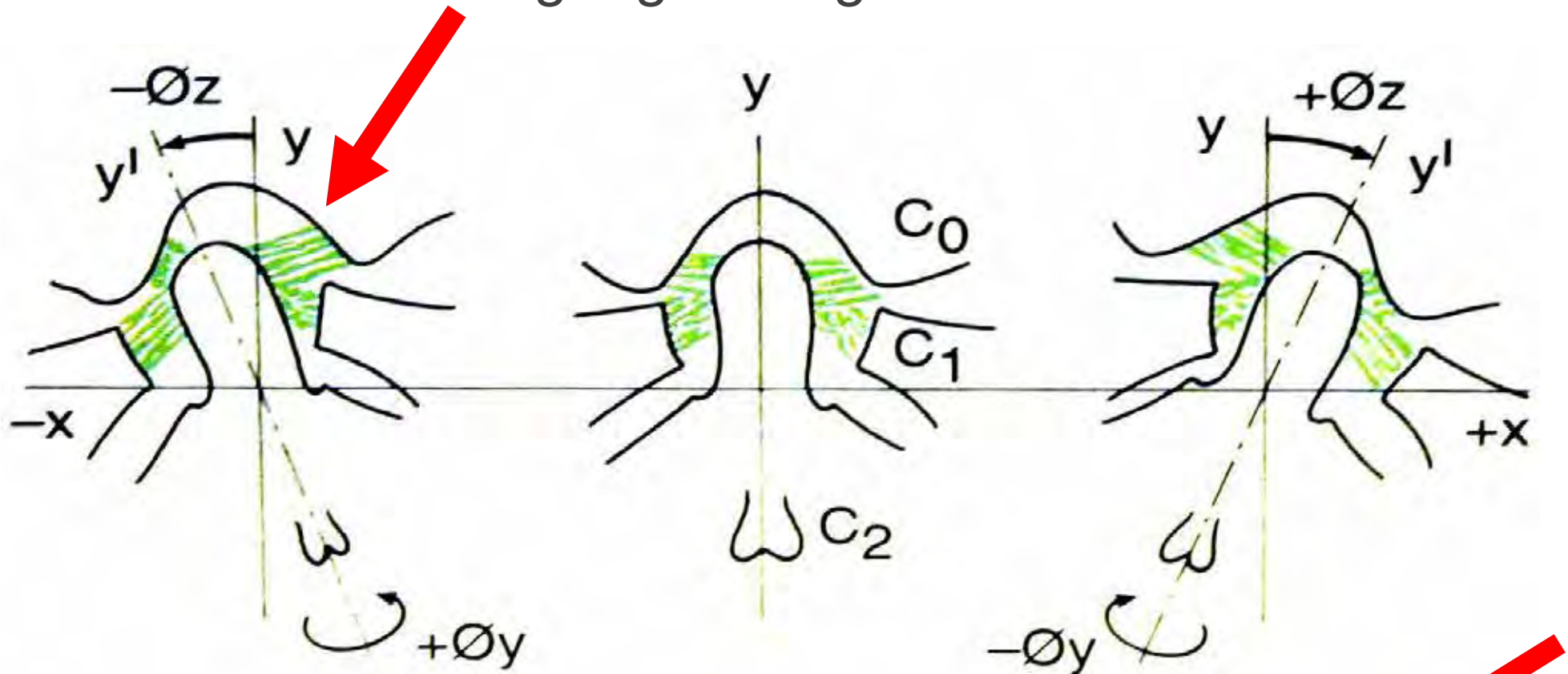
C0/1 3-5°

C1/2 je li/re 38-43°

Dvorak 1987, 94,
Pfirman 2000



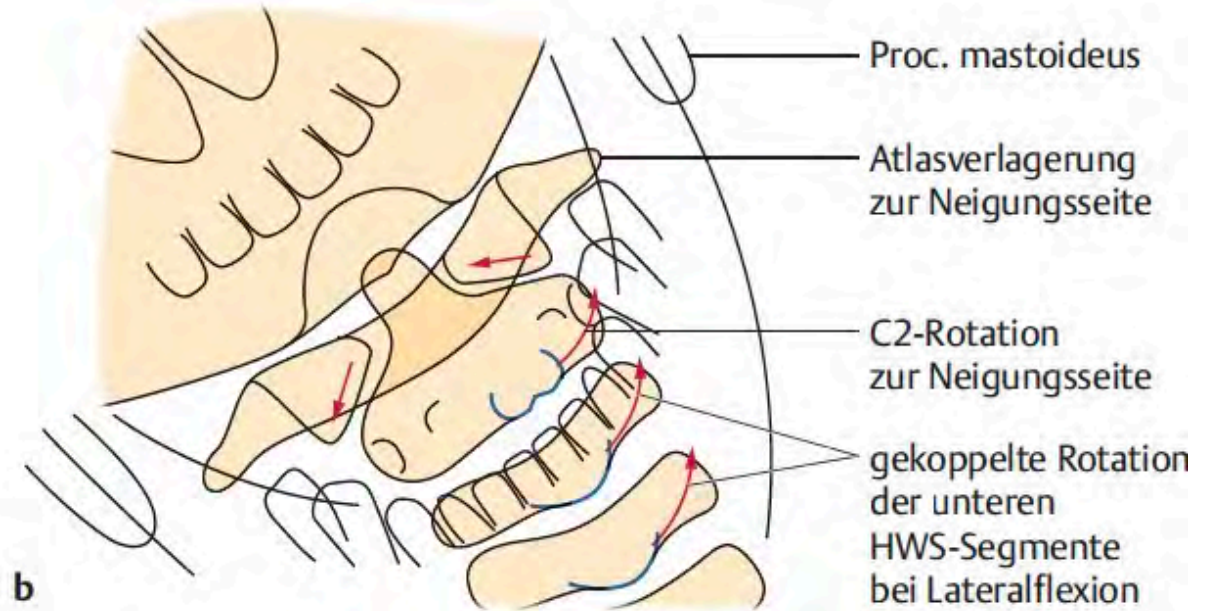
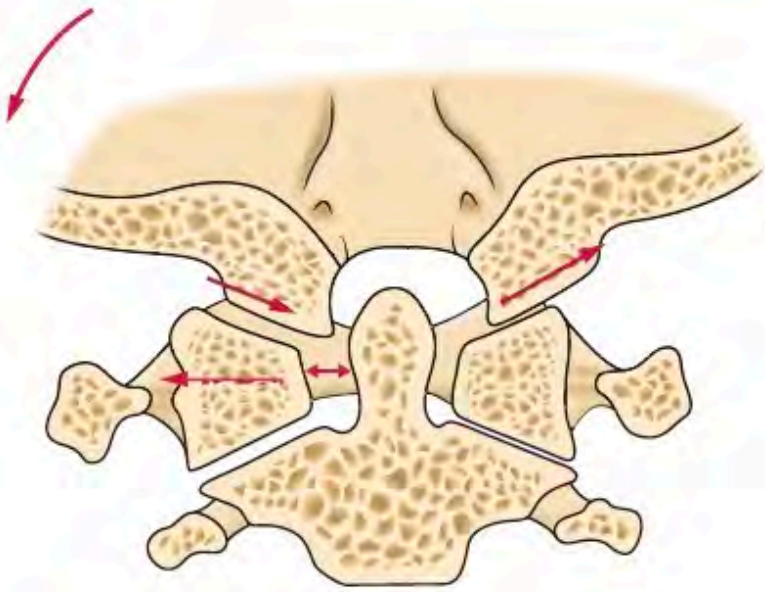
Seitneigung/Zwangsrrotation C2



- Lig. alare (occipitale) begrenzt Lateralgleiten des Atlas
- Exzentrischer Ansatz am Dens induziert gleichsinnige Zwangsrrotation des Atlas

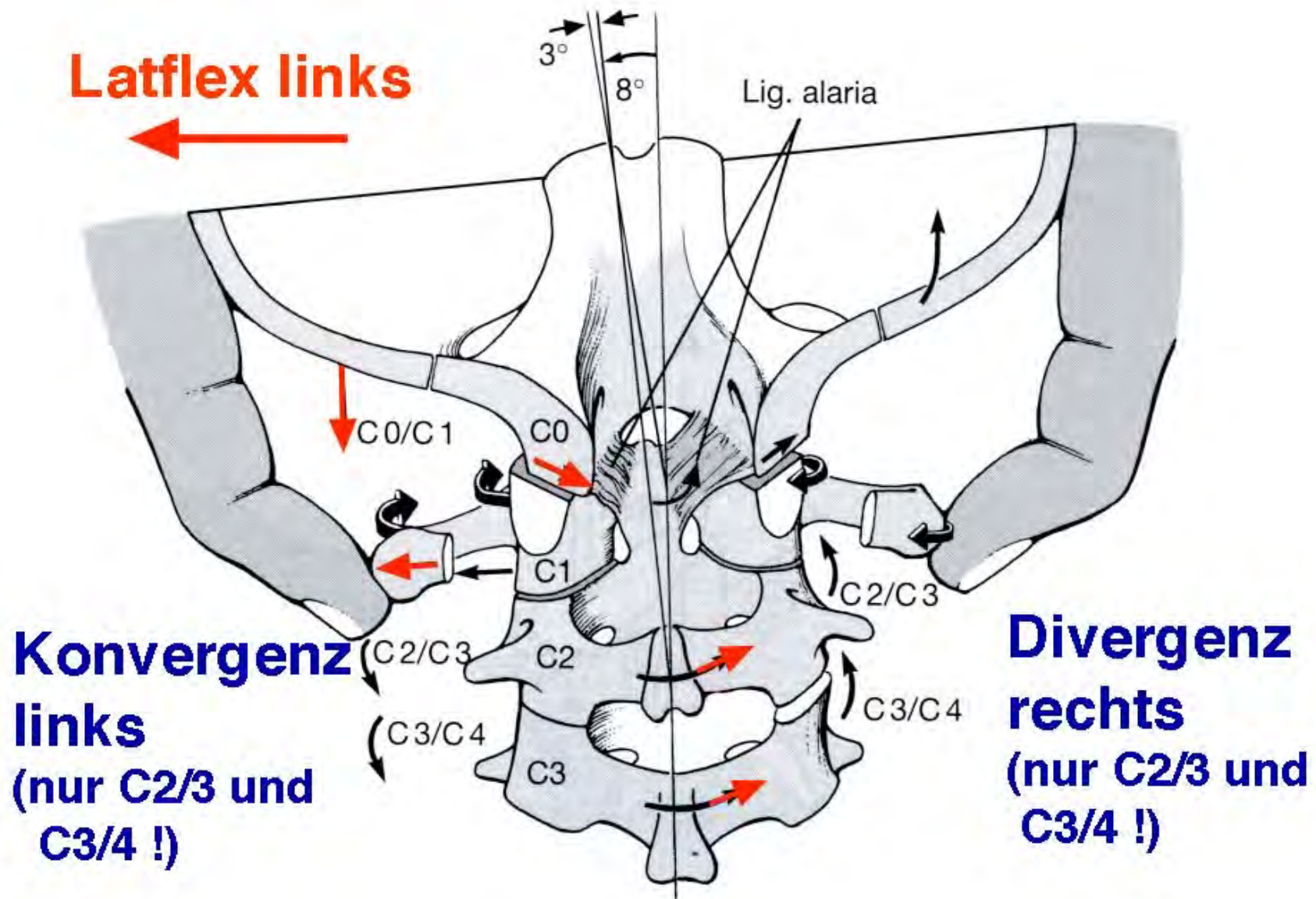
Oberer → unterer HWS:
Seitneigung

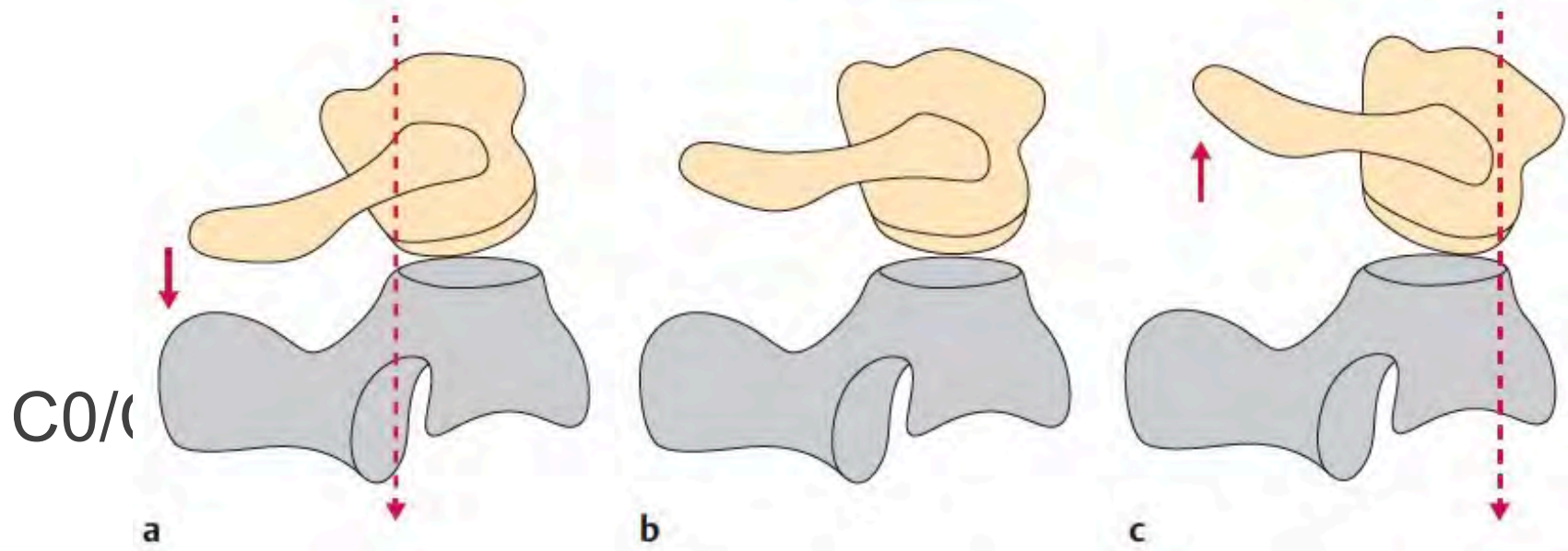
C0/C1: 3 - 5°: "Kondylengleiten" (passiv)



Seitneigung ab C2/3 gekoppelt mit Rotation
(„Zwangsrotation des Axis C2“)

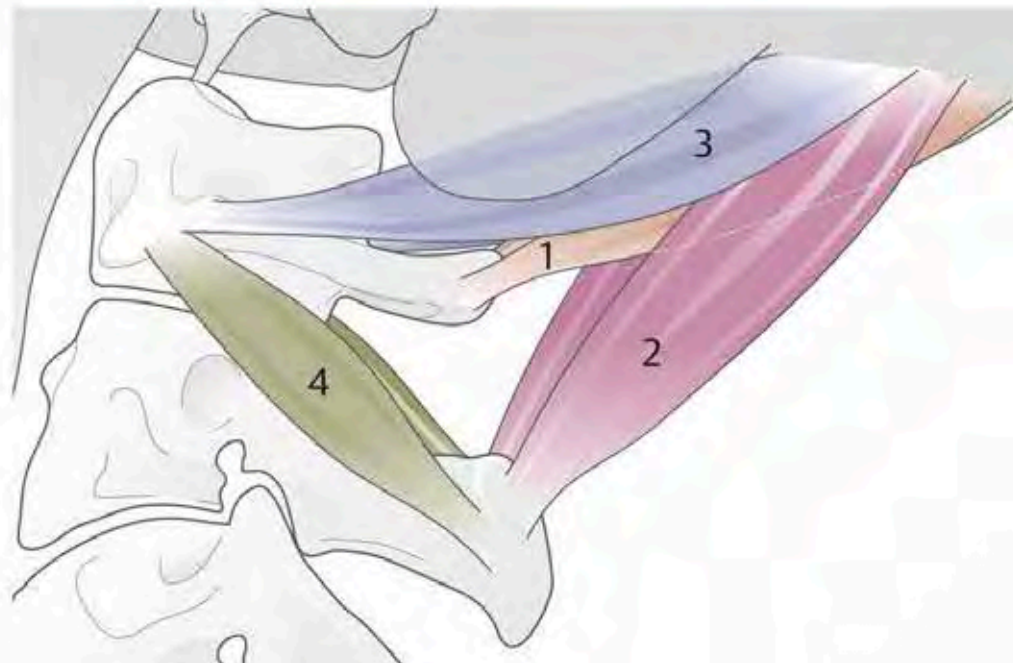
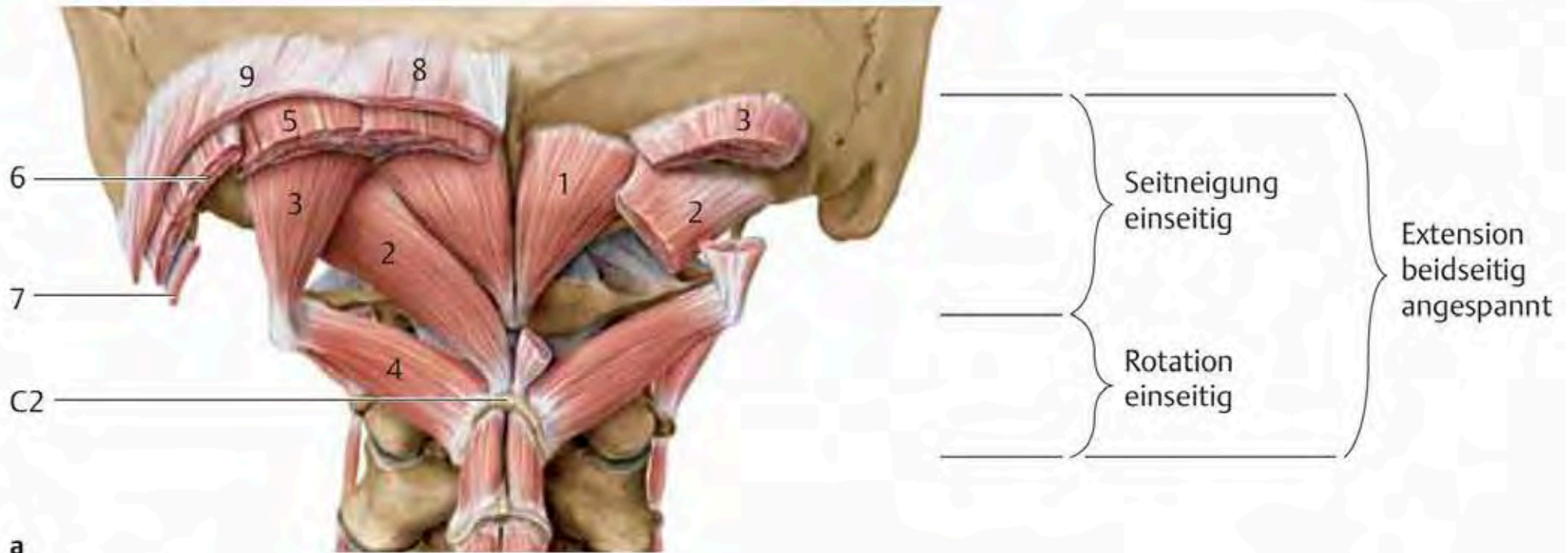
Palpation bei Lateralflexion





C1/C2: 10 – 15° → maximale Flexion „paradoxe Kippung Atlas“ nach dorsal

(Atlanto-dentaler Abstand
in den Funktionsaufnahmen seitlich!)



- 1 = M. rectus capitis posterior minor
- 2 = M. rectus capitis posterior major
- 3 = M. obliquus capitis superior
- 4 = M. obliquus capitis inferior

b

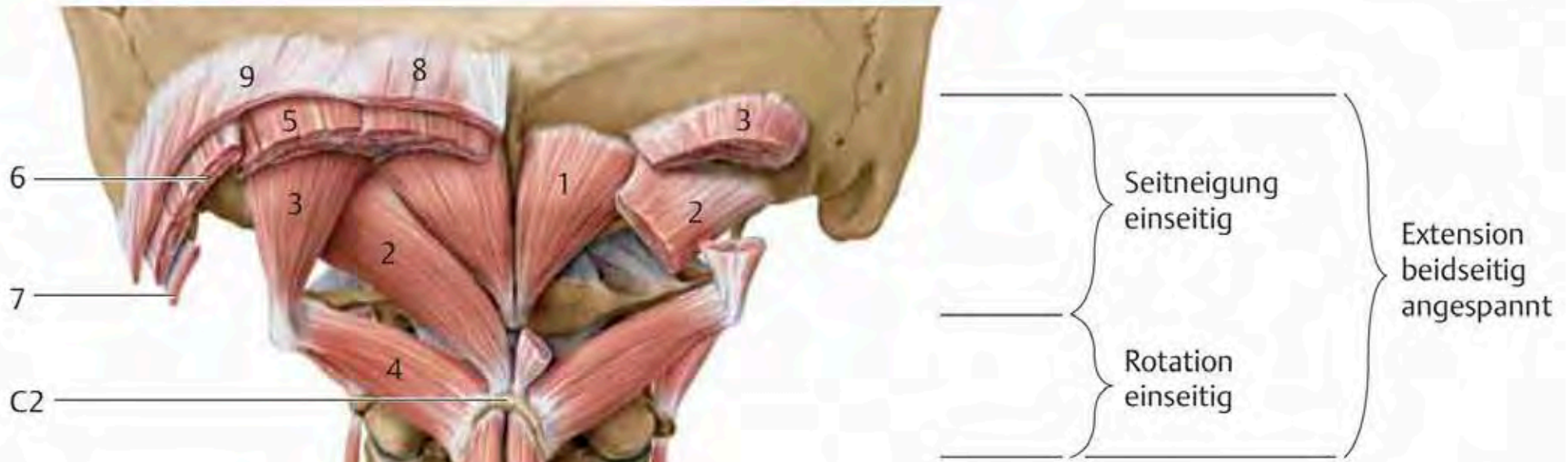


Abb. 4.11 402. Palpation und Testung der subokzipitalen Muskulatur.

a Kontaktpunkt unmittelbar subokzipital paramedian oberhalb und lateral des Dornfortsatzes C2.

b Ellenbogen auf der Liege, während der Kopf auf beiden Thenaren des Therapeuten liegt.

A. vertebralis
im Foramen
transversarium

Dens axis

Art. atlanto-
axialis lateralis

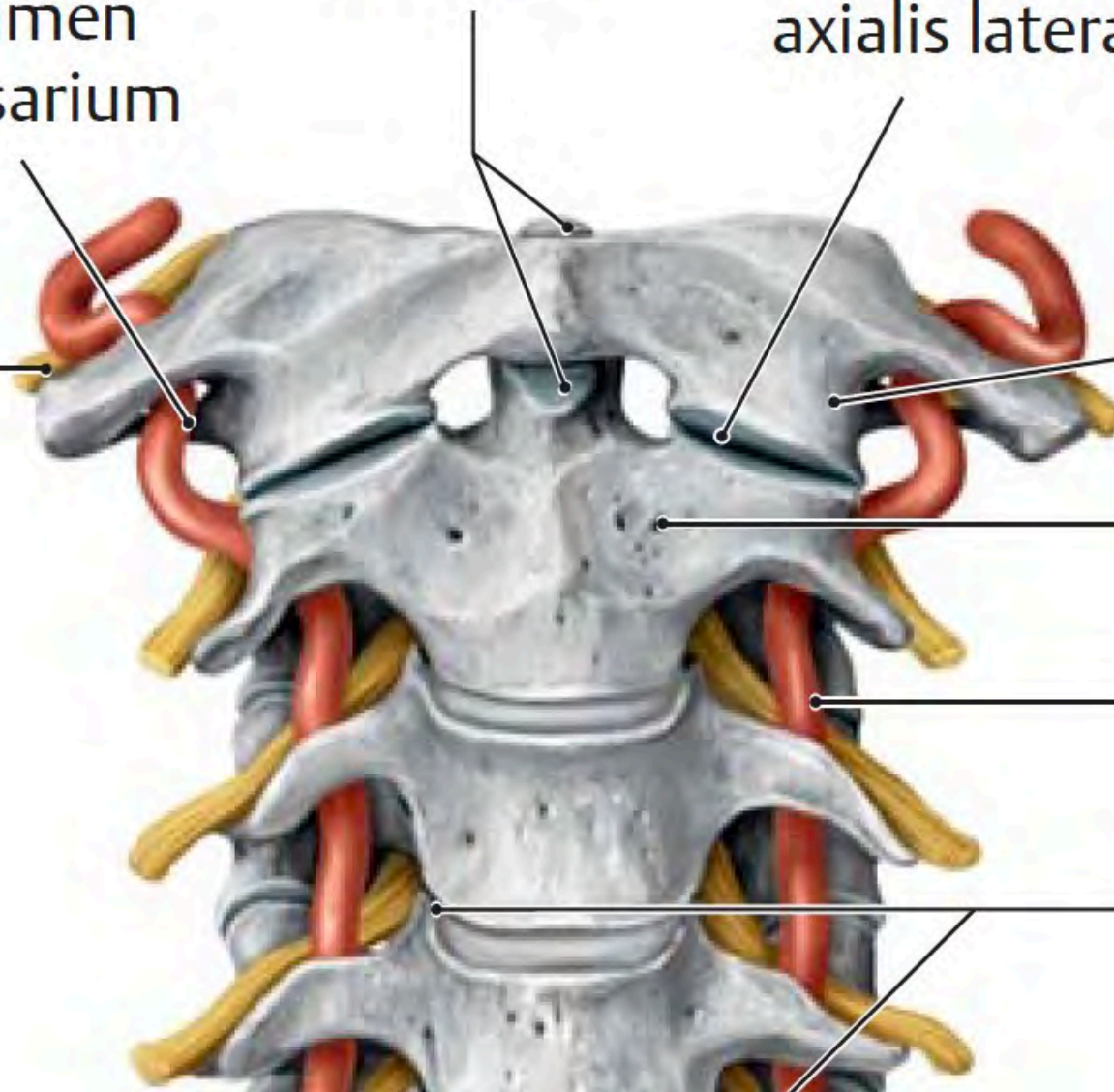
N. spinalis
C1

Atlas (C I)

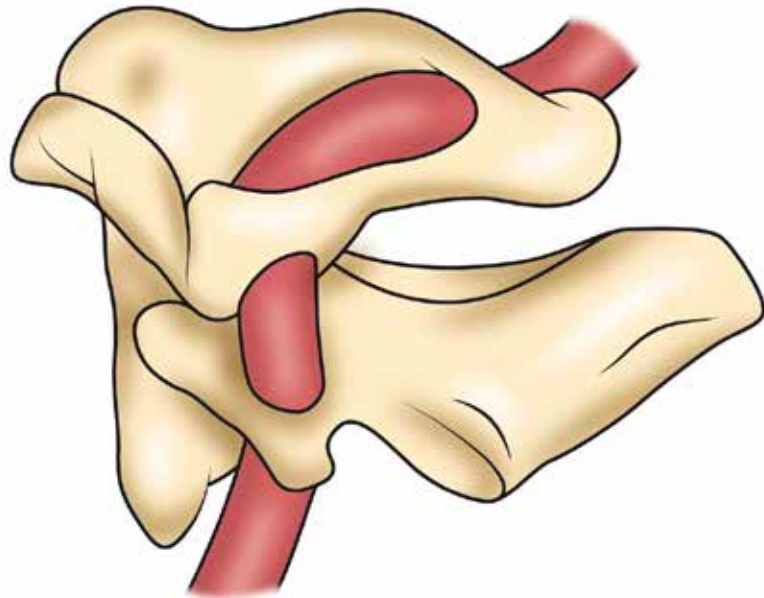
Axis (C II)

A. vertebralis

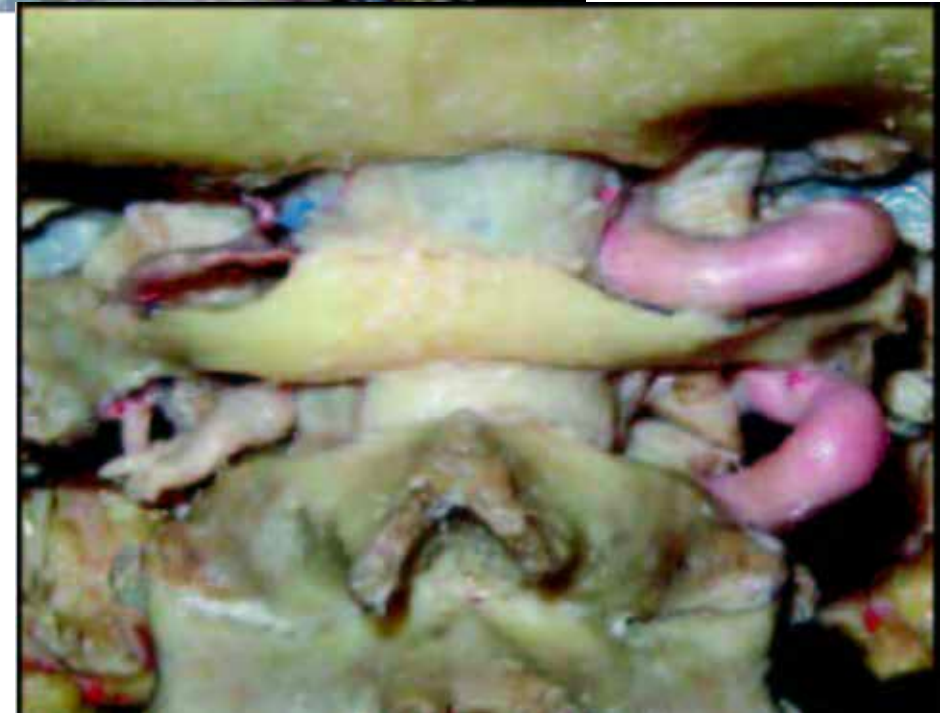
Proc.
uncinatus



A. vertebralis

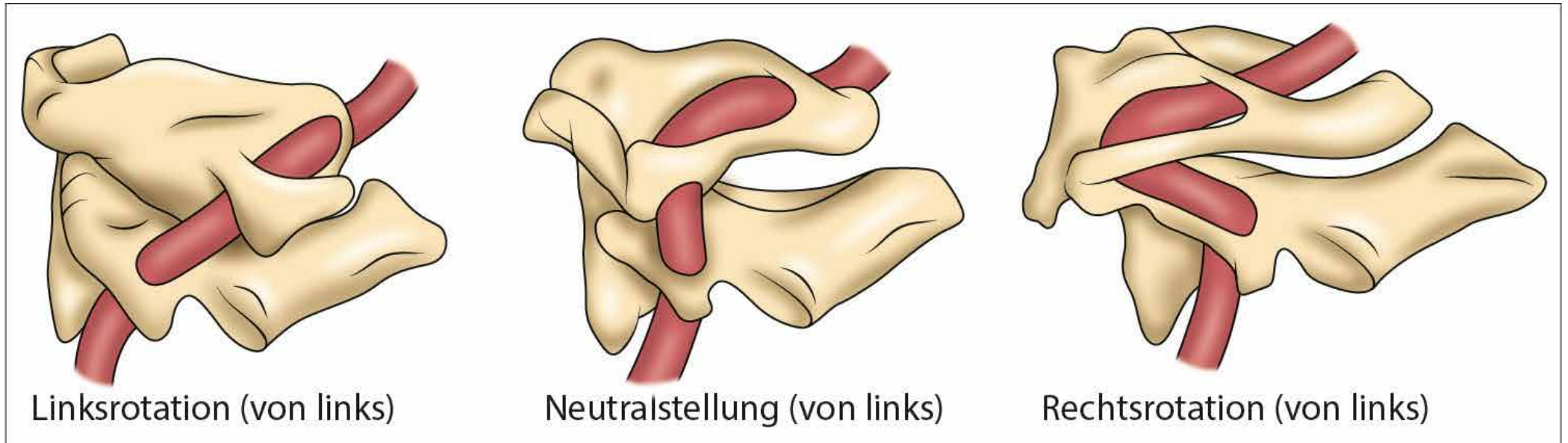


Neurol India 2004;
52:178-84
Cacciola et al.



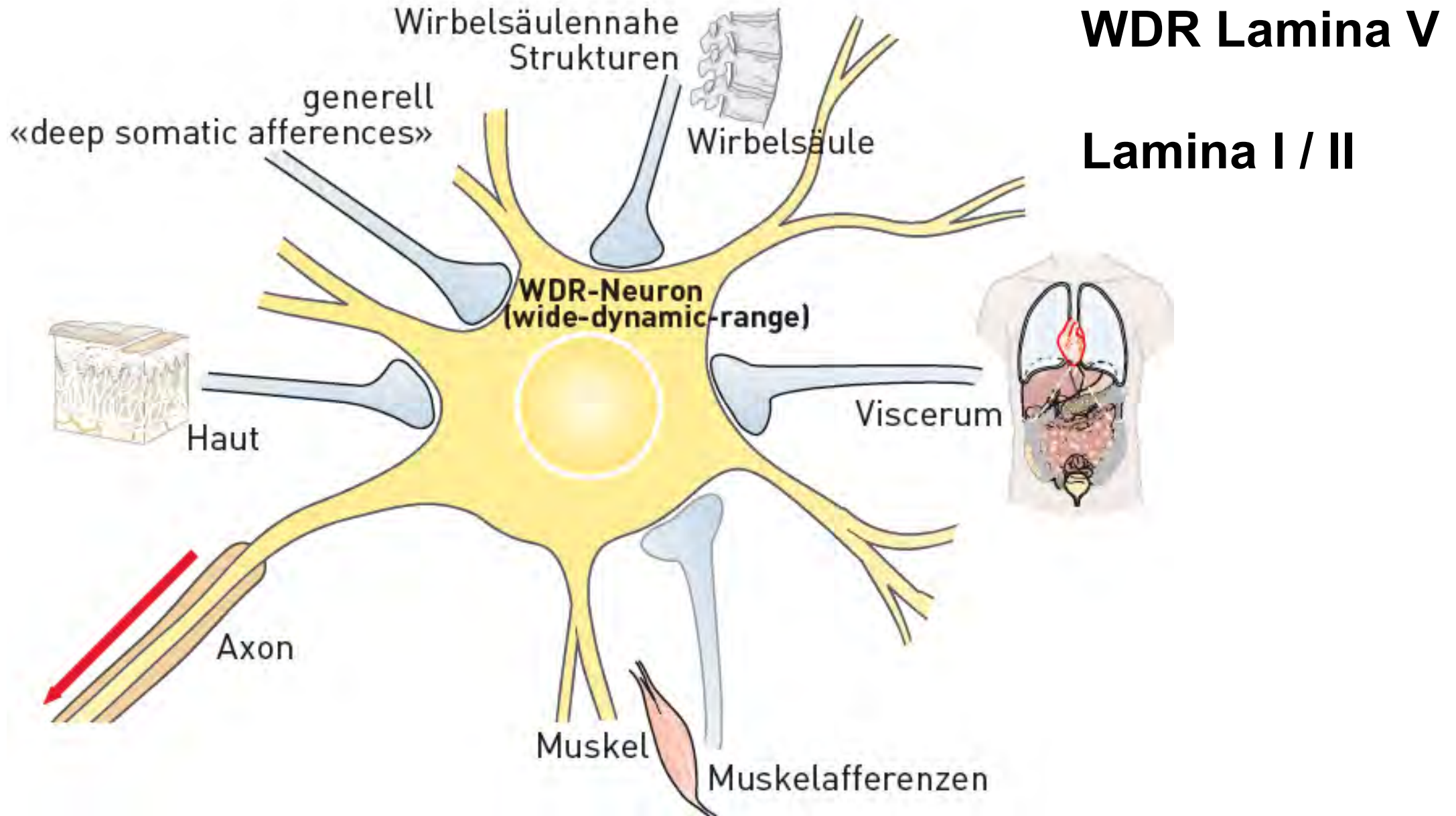
White&Panjabi 1997
(Nach Fielding)

A. Vertebralis – „Stress“ durch Rotation



Aus © Böhni et al MM Band 1 2022
White&Panjabi 1997 (Nach Fielding)

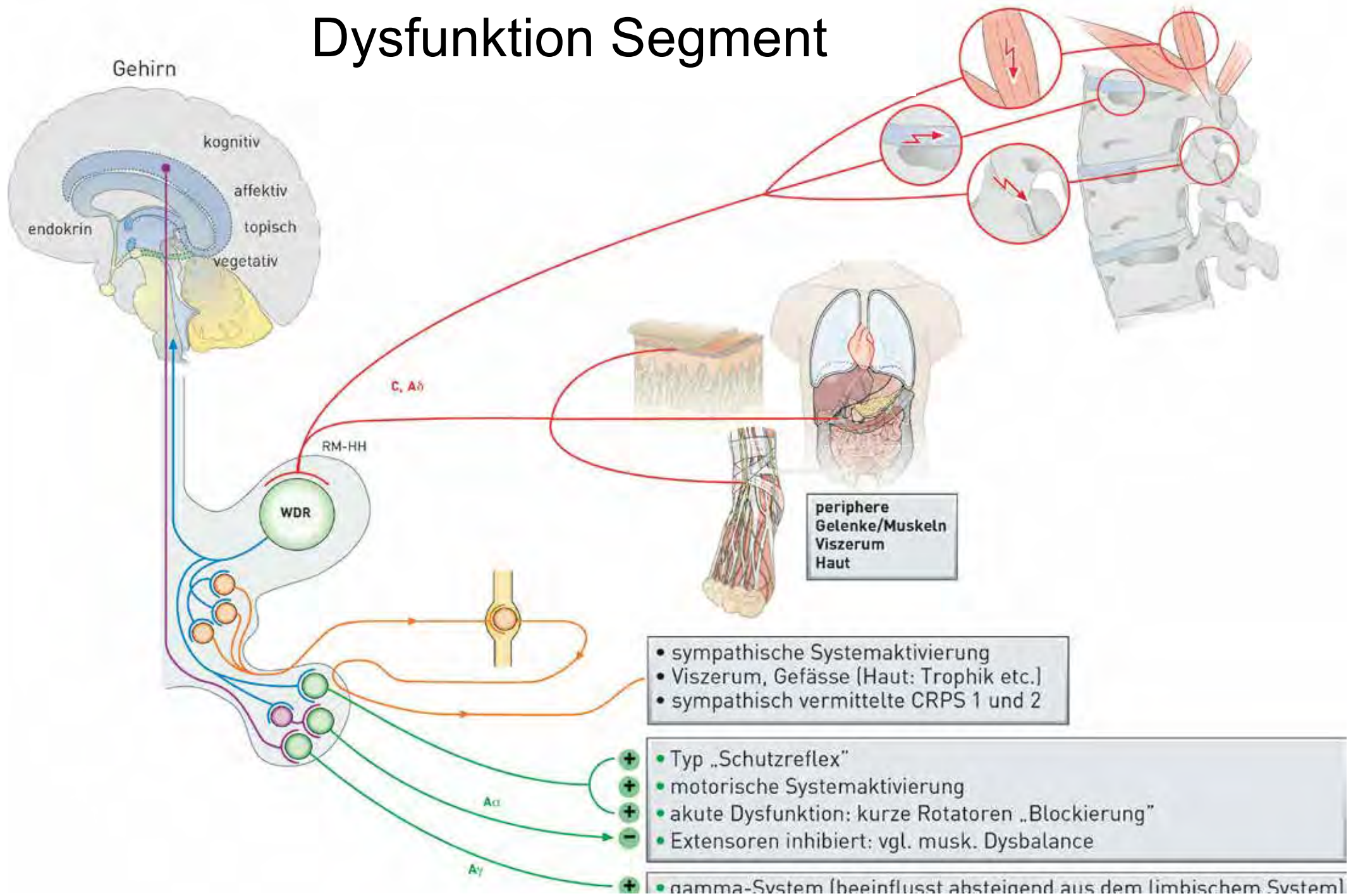
Multirezeptive, sensorische Konvergenz:

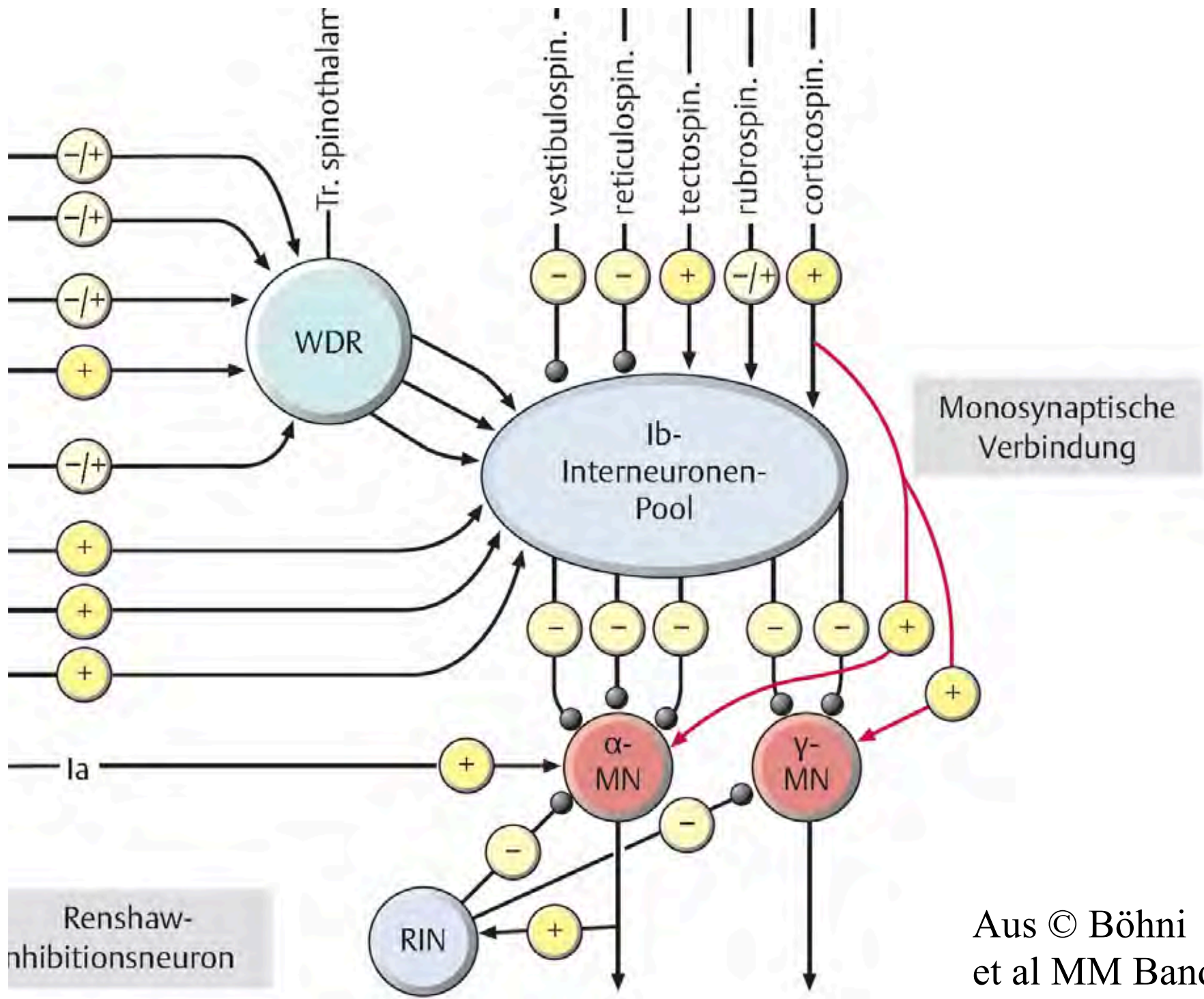


Konvergenz der Noziafferenzen

- → ***Unspezifisch*** bezüglich Ursache im afferenten Einzugsgebiet:
 - Myofazial – artikulär // alle „tiefsomatischeN Gewebe“ = mögliche Afferenzen
 - Viscerosensorische Afferenzen
 - Wahrnehmung zentral „irgendwo“
 - reflektorische „Antwort“ z.B. myofaszial oder segmentale Dysfunktion „irgendwo“

Dysfunktion Segment

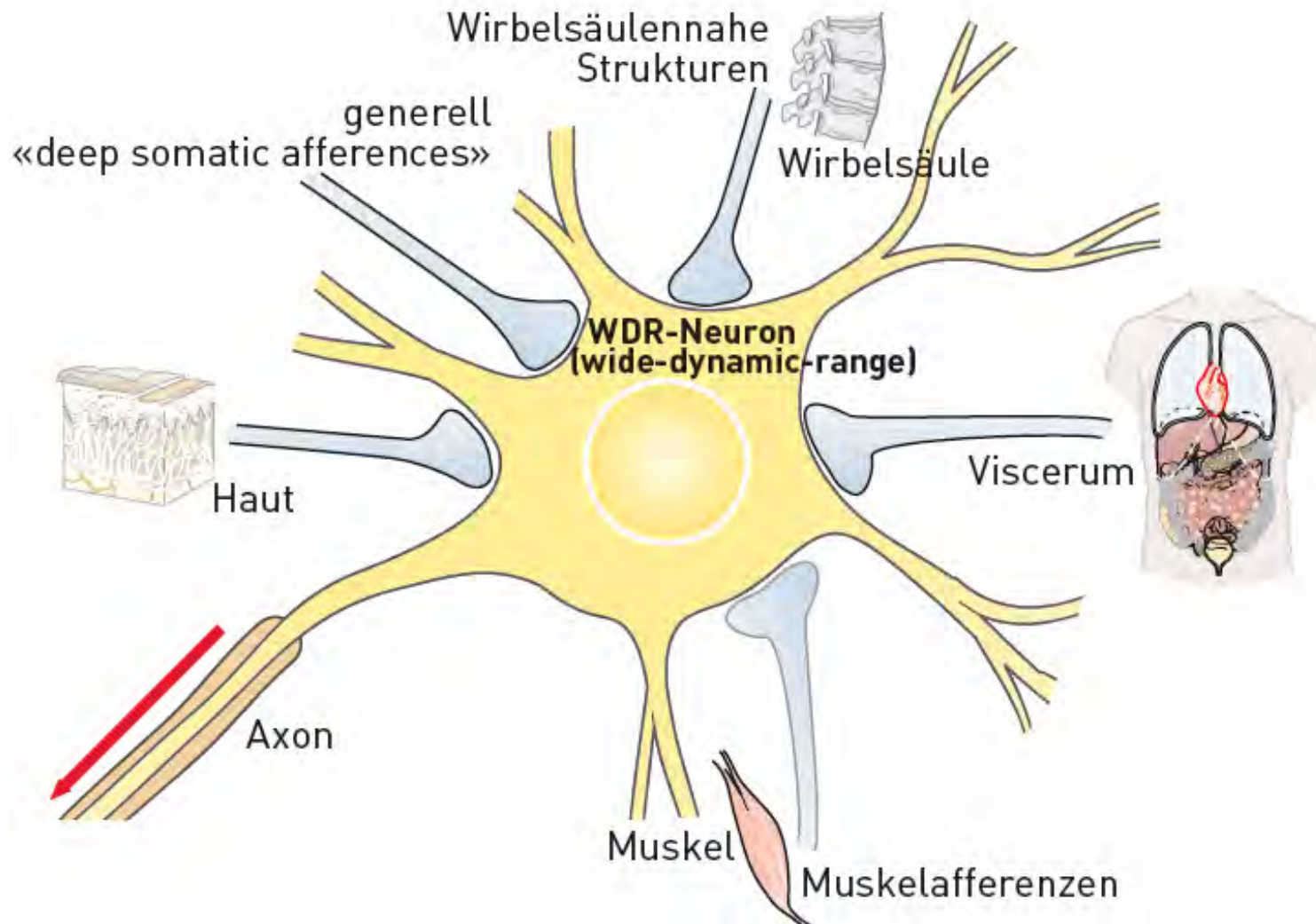




Renshaw-
inhibitionsneuron

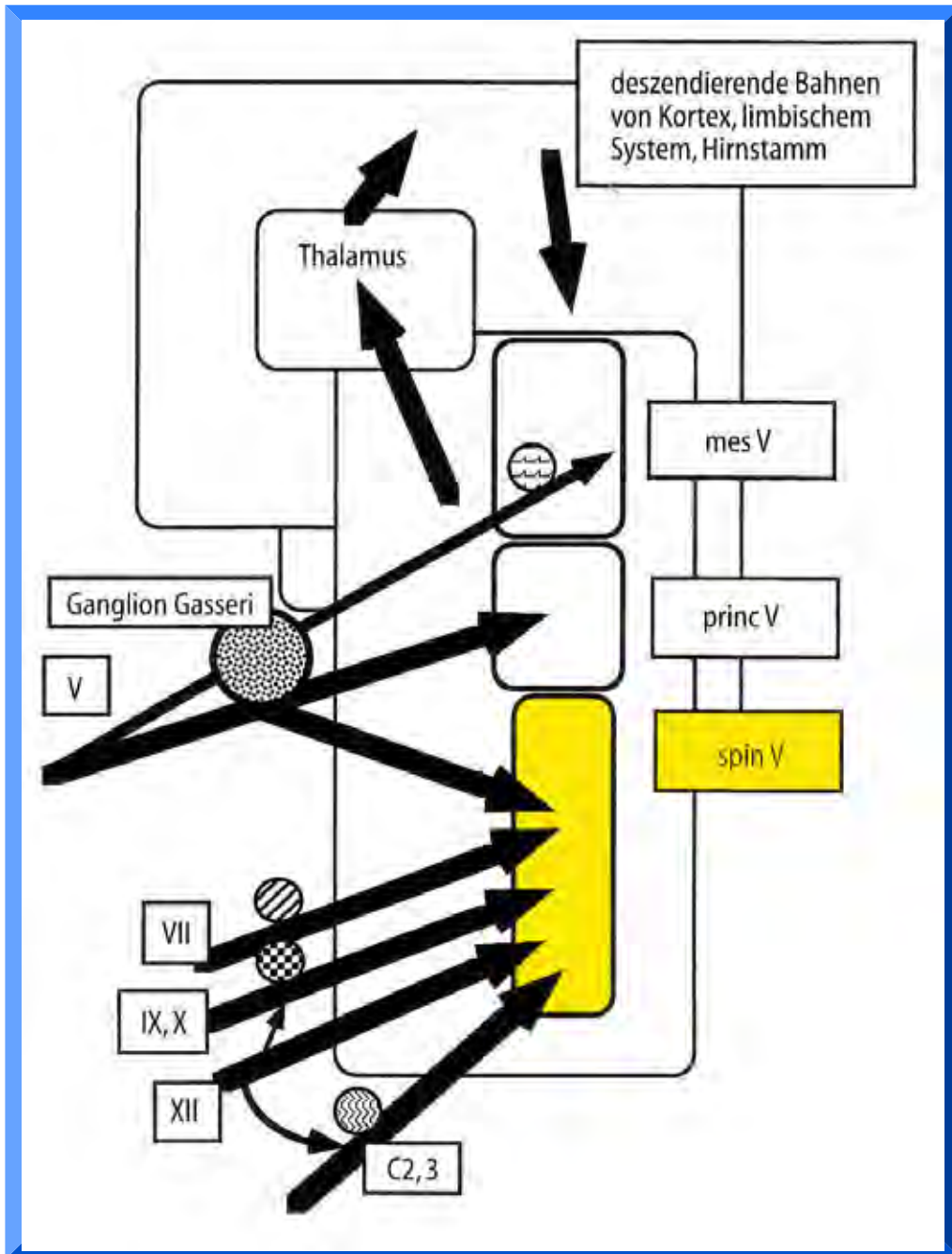
Aus © Böhni
et al MM Band 1 2014

Multirezeptive, sensorische Konvergenz → an der oberen HWS erweitert!



Pathogenese – Noziafferenzen aus . . . Anatomie:

- **C1:**
 - Atlantooccipitalgelenk (*N.suboccipitalis*)
 - Kopfgelenksligamente
- **C2:**
 - Atlantoaxialgelenk (*N.occipitalis major*)
 - Mm. suboccipitales, Mm. st.cl.mast., M. trapezius, M. semispinalis capitis, M. splenius Mm. scaleni,
 - Dura hintere Schädelgrube, zervikales Rückenmark
 - **A. vertebralis !**
- **C2:**
 - Gelenk C2/3 / Discus (*TON: 3. Occipitalnerv*)
- **C3:**
- **Konvergenzprinzip obere HWS-Region C1-3 !**



Nucleus (Tractus) spinalis

Nervi trigemini:
Konvergenz der
Afferenzen

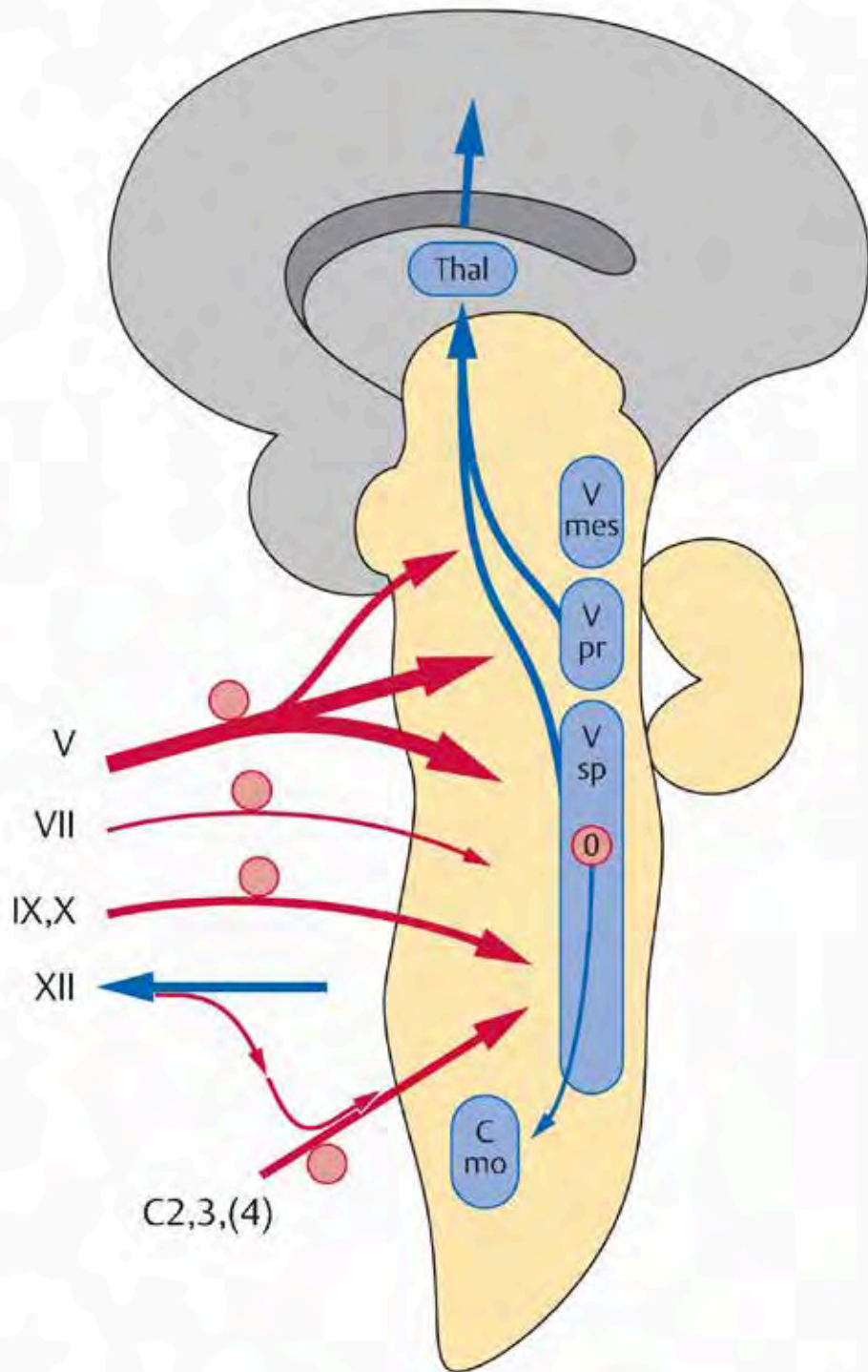
C1-3 und N. V

VII, IX, X und XII

©Neuhuber, Erlangen

Nucleus spinalis
Nervi trigemini V sp
Konvergenz der
Afferenzen
C1-3 und N. V
*„zervikotrigeminale
Konvergenz“*
VII, **IX**, **X** und XII

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Manuelle Medizin I



„Oberes cervicogenes Beschwerdesyndrom“ =
Cervicocephales Syndrom ICD10 M53.0

- Alle somato-sensorischen Afferenzen aus:
 - dorsale und ventrale Wurzeln C1 (Dura, Musk.) C2 C3
 - Trigeminus V1 (Dura !); V2 (Kiefergelenk); V3
 - VII, IX. X (XI ad C1-3(4) !)
- Können fortgeleitet werden:
 - „**Referred pain**“: z.B. cervicogener Kopfschmerz, Gesichtsschmerz, Nackenschmerz, . . .
 - „**Referred symptoms**“: Gleichgewichtsstörungen, „Schwindel“, Globusgefühl, unspezifische Ohr- und Augensymptome, Tinnitus-artige Phänomene,

Ursachen-unspezifisch !!

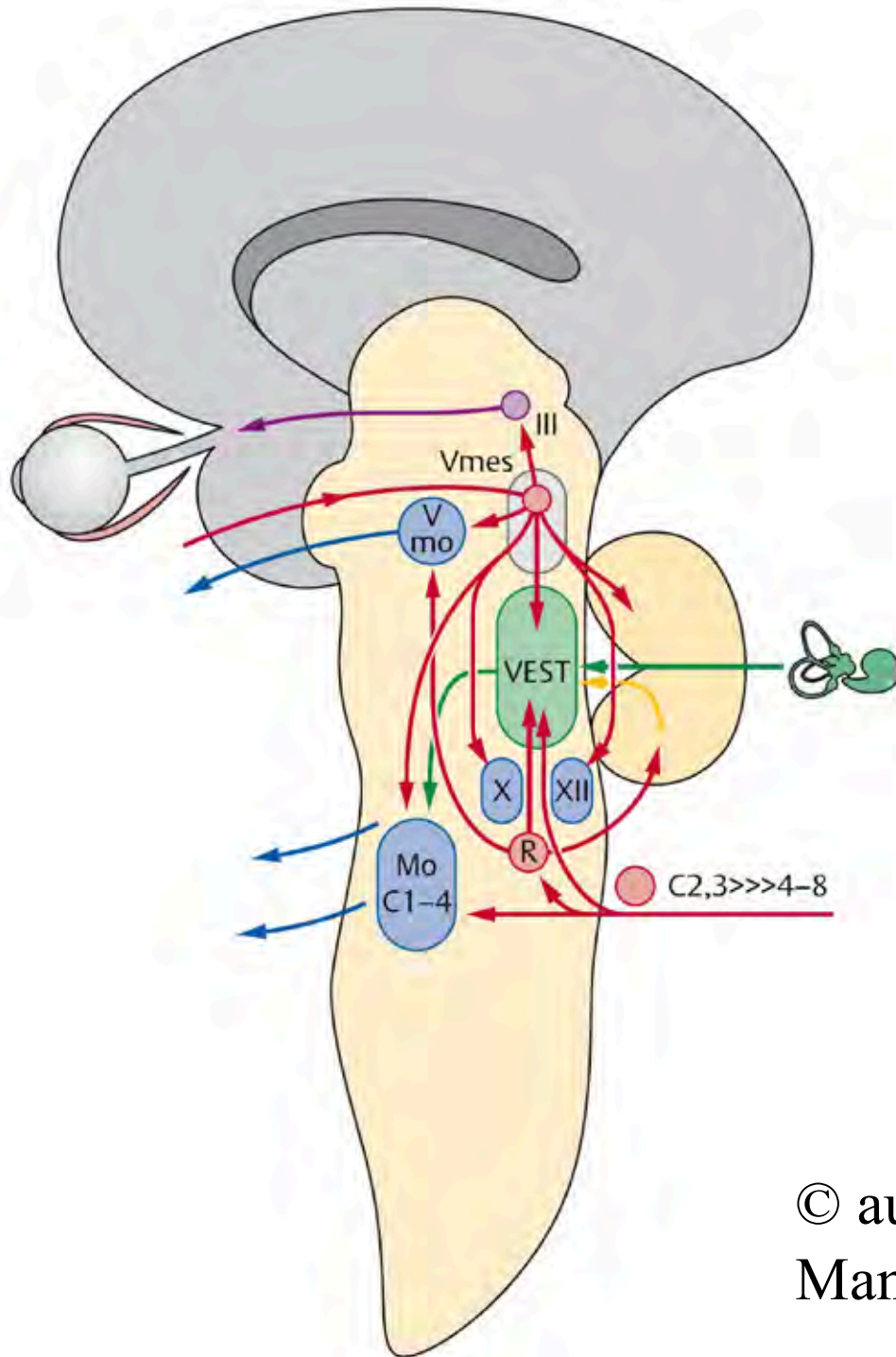
Oberes cervicogenes Beschwerdesyndrom = *Cervicocephales Syndrom ICD10 M53.0*

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 - o Trigeminus V1 (Dura !); V2 (Kiefergelenk); V3
 - o VII, IX. X (XI ad C1-3(4) !)

***Schnittstelle zum
Kraniomandibulären System***

Ursachen-unspezifisch !!

Proprioception und Vestibulariskerngebiet



Konvergenz propriozeptiver Afferenzen aus Kau- und Halsmuskelapparat →:

- Vestibulariskernkomplex (VEST)
- zervikalen Motorneuronen (Mo C 1–4)
- motorischen Trigeminskern

Beachte: über den Ncl. cervicalis centralis CNN auch zum kontralateralen VEST

© aus Böhni et al 2015

Manuelle Medizin I

„Schwindel“ Gleichgewichtsstörung

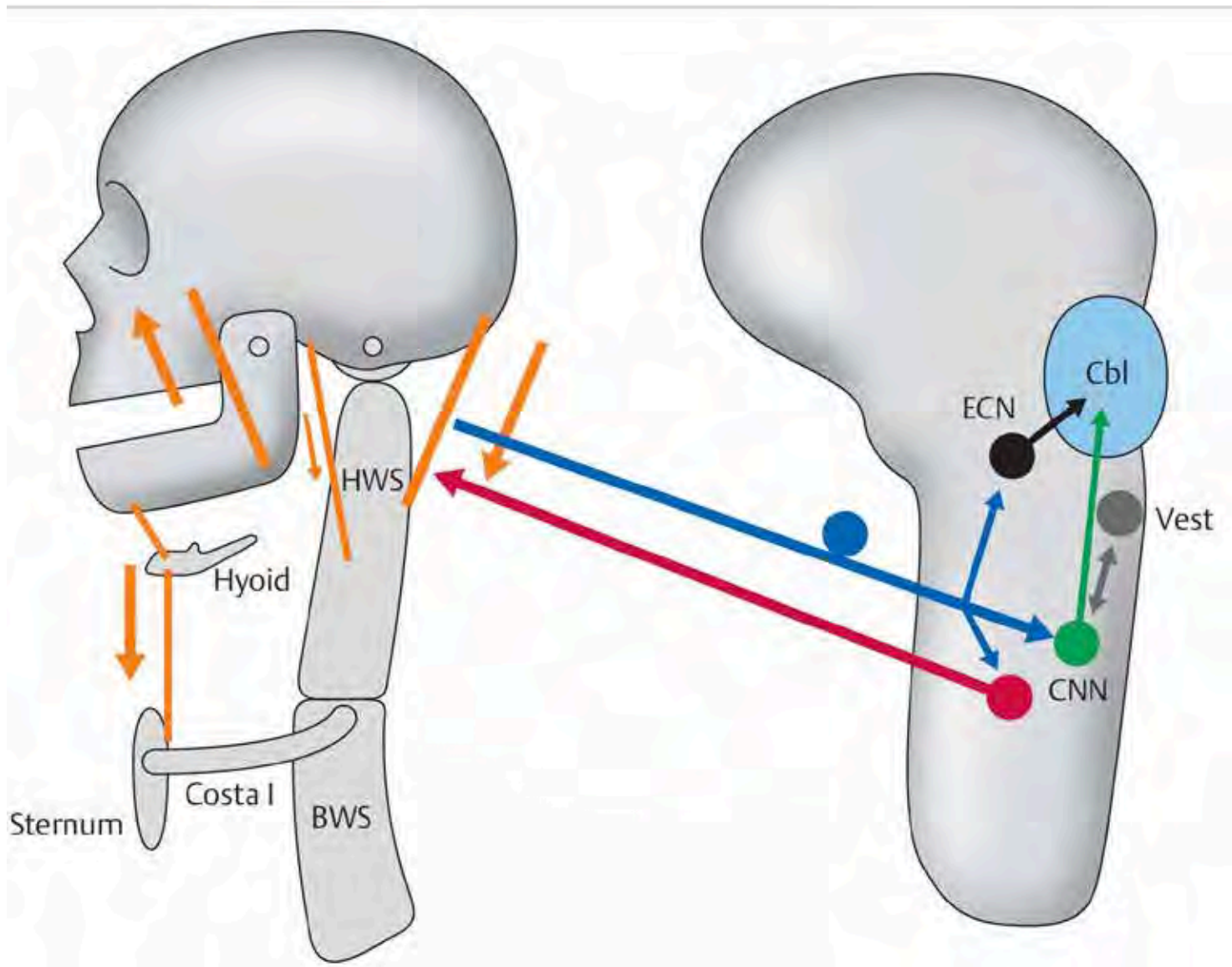


Abb. 5.20 Die propriozeptiven Affere den Halsmuskeln (dargestellt pars pro der Nackenmuskulatur, blau) werden direkt auf die zervikalen Motoneuron verschaltet. Eine aufsteigende Projekt zum Ncl. cuneatus externus (ECN, schwarz) ein wichtiges Relais für Halsproprioze ipsilateral zum Kleinhirn (Cbl) darstell zweite wichtige Relaiskern ist der Ncl. centralis (CNN, grün) im Halsmark, der falls, allerdings kontralateral, zum Kle projiziert. Er steht aber auch reziprok Vestibulariskernen (VEST, grau) in Ver (nach Neuhuber)

PAI 00955

Basic Section

Convergence of cutaneous, tooth pulp, visceral, neck and muscle afferents onto nociceptive and non-nociceptive neurones in trigeminal subnucleus caudalis (medullary dorsal horn) and its implications for referred pain

B.J. Sessle, J.W. Hu, N. Amano and G. Zhong

Faculty of Dentistry, University of Toronto, Toronto M5G 1G6 (Canada)

(Received 28 October 1985, revised received 28 February 1986, accepted 12 March 1986)

Convergence of cutaneous, musculoskeletal, dural and visceral afferents onto nociceptive neurons in the first cervical dorsal horn

C. D. Mørch,¹ J. W. Hu,² L. Arendt-Nielsen¹ and B. J. Sessle²

¹Center for Sensory–Motor Interaction, Aalborg University, Aalborg, Denmark

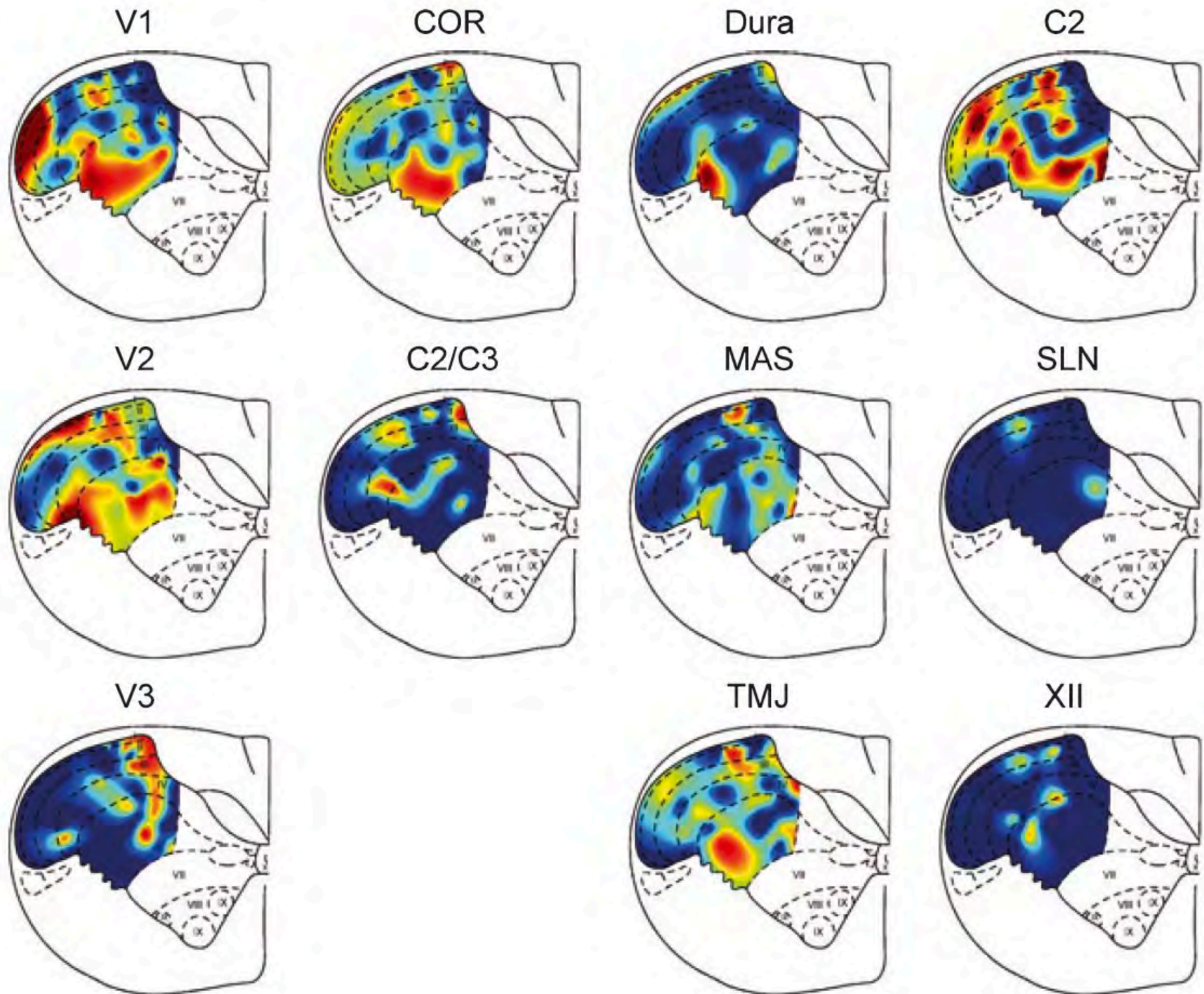
²Faculty of Dentistry, University of Toronto, 124 Edward Street, Toronto, Ontario, Canada M5G 1G6

Keywords: neck, rat, sensory integration, somatotopy

Abstract

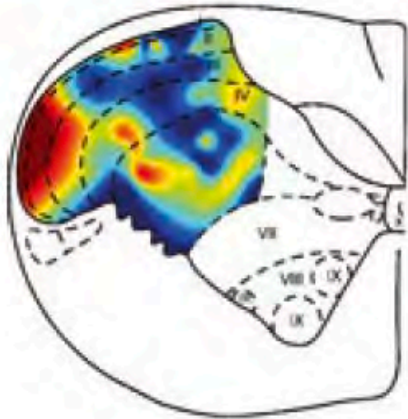
The convergence of cutaneous, musculoskeletal, dural and visceral afferents onto nociceptive neurons in the first cervical dorsal horn was investigated in urethane/chloralose-anesthetized rats. Electrical stimulation was applied to facial, neck, shoulder and forepaw skin, cornea (COR), dura, second cervical (C2) nerve, hypoglossal nerve, temporomandibular joint, masseter (MAS) muscle and superior laryngeal nerve. In addition, acetic acid was injected intraperitoneally and microinjection of glutamate was applied to the tongue, MAS muscle, splenius cervicis muscle, dura and intrapericardial area. A total of 52 nociceptive neurons classified as wide dynamic range ($n = 28$) or nociceptive-specific ($n = 24$) was studied. All nociceptive neurons received afferent input from the skin and at least one COR, musculoskeletal, dural or visceral afferent source in the trigeminal (V) or cervical area but input from afferent sources caudal to the C2 innervation territory was sparse. The proportion of neurons responding to COR, dural, C2 nerve, hypoglossal nerve, temporomandibular joint, MAS muscle and superior laryngeal nerve stimulations was 87, 54, 85, 52, 73, 64 and

A

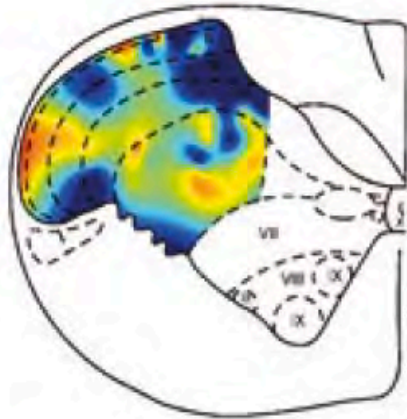


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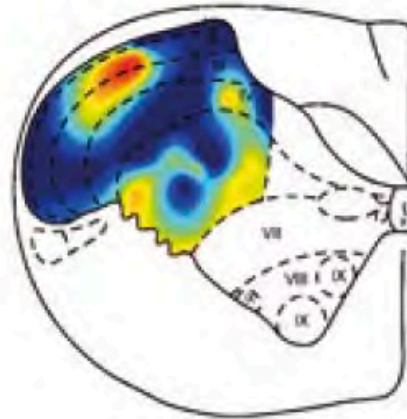
V1



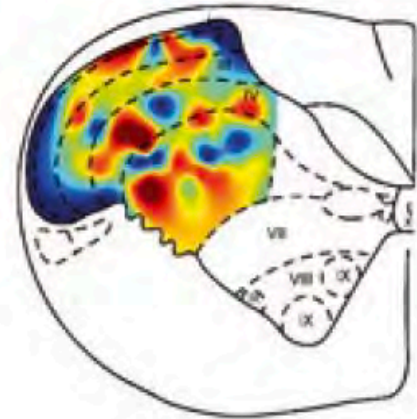
COR



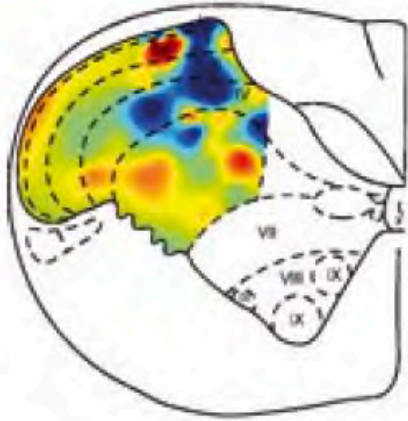
Dura



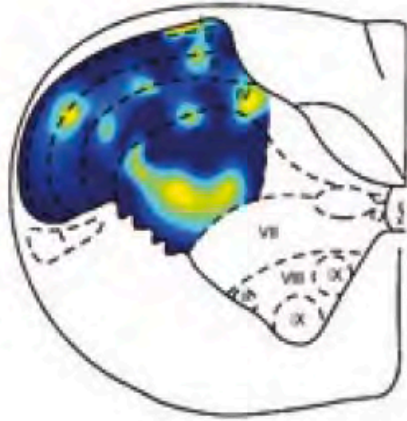
C2



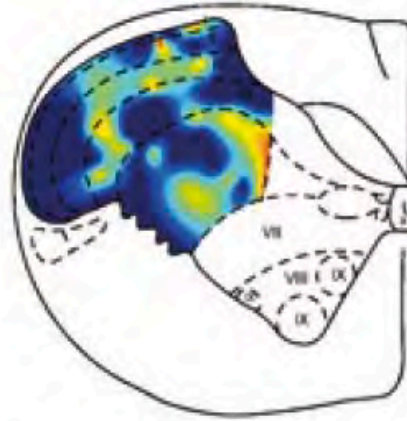
V2



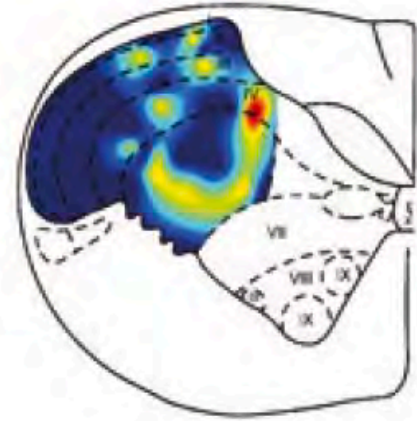
C2/C3



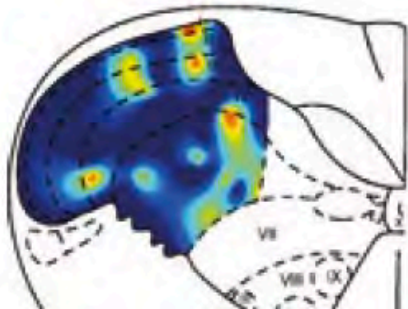
MAS



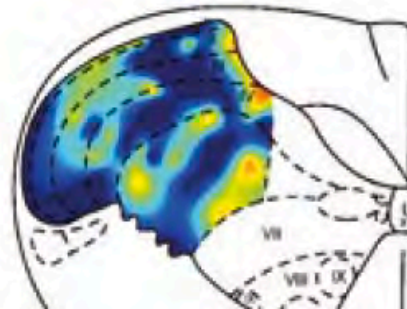
SLN



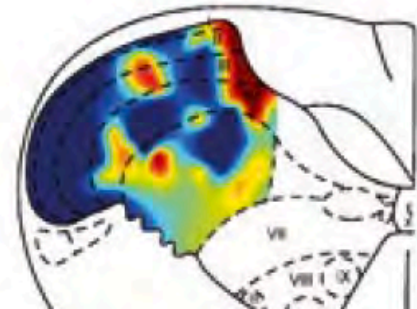
V3



TMJ



XII



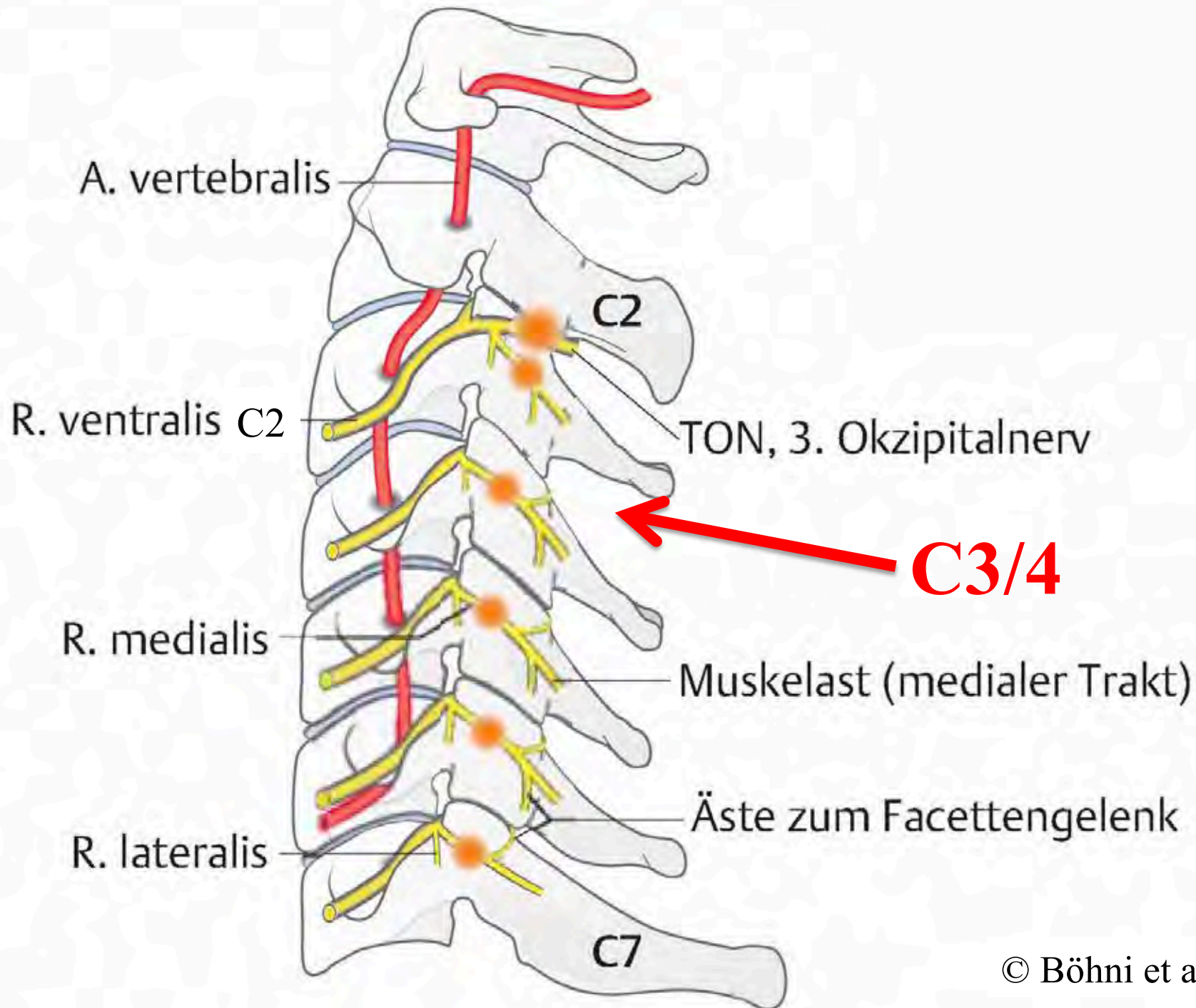
Disease Focus

Editor's Note: Disease Focus articles provide brief overviews of a neural disease or syndrome, emphasizing potential links to basic neural mechanisms. They are presented in the hope of helping researchers identify clinical implications of their research. For more information, see http://www.jneurosci.org/misc/ifa_minireviews.dtl.

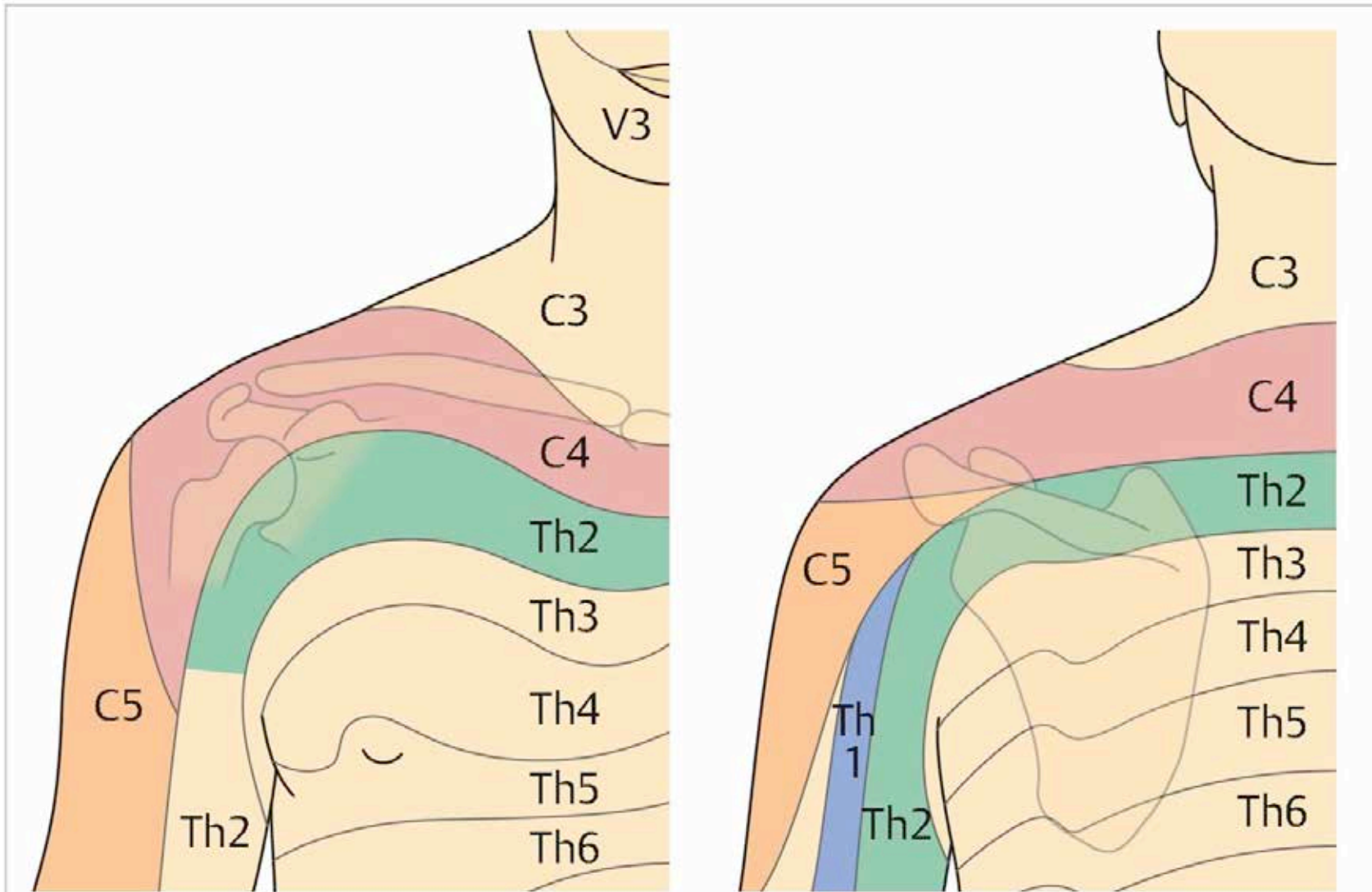
The Role of the Trigeminal Sensory Nuclear Complex in the Pathophysiology of Craniocervical Dystonia

Lynley Bradnam^{1,3} and Christine Barry^{1,2}

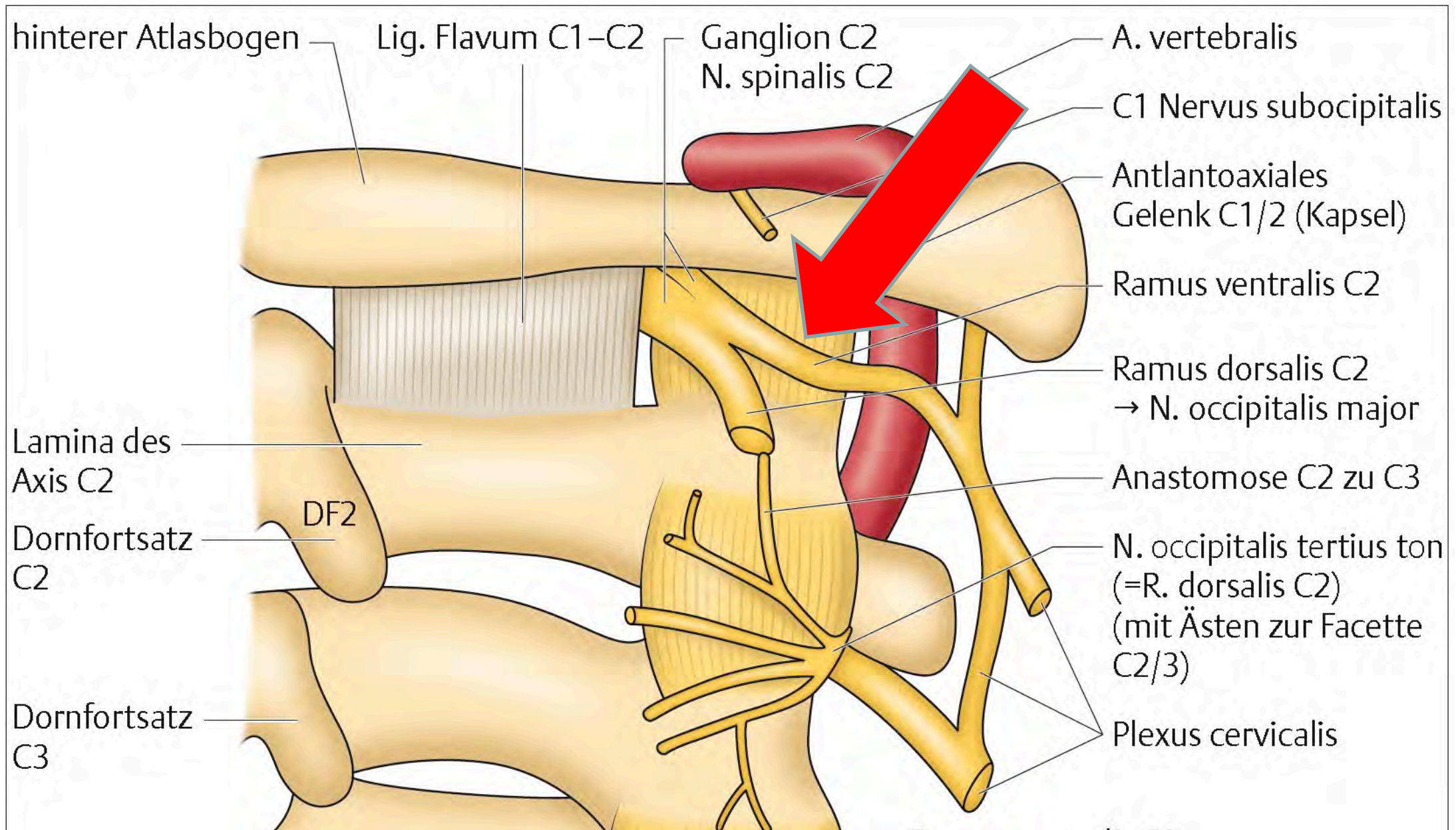
¹Applied Brain Research Laboratory, Centre for Neuroscience, ²Department of Anatomy and Histology School of Medicine, and ³Effectiveness of Therapy Group, Centre for Clinical Change and Healthcare Research, School of Medicine, Flinders University, Bedford Park 5042, South Australia, Australia



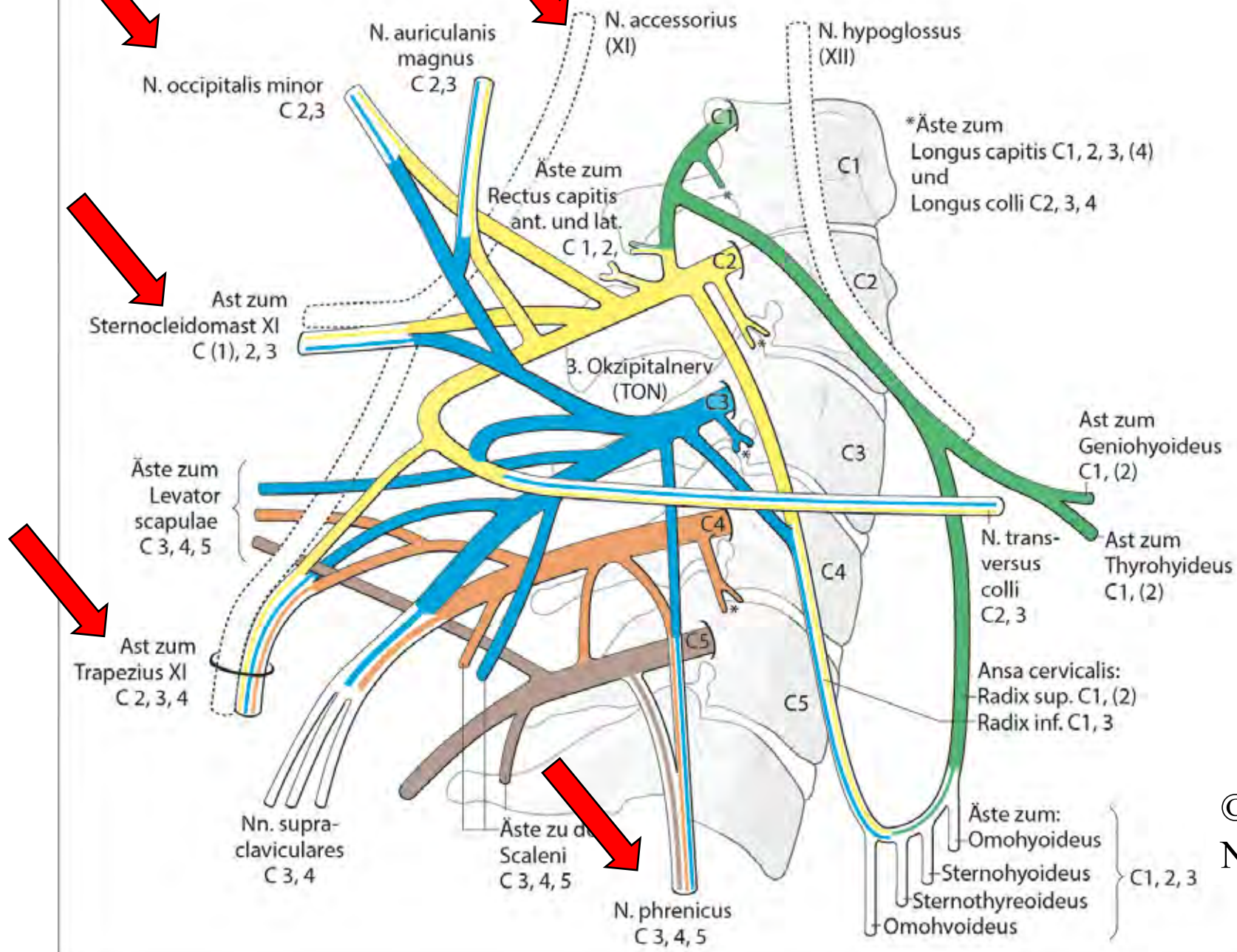
Schmerzprojektion C3/4: Kopf (C2) und Schulter(C3)



N. occipitalis major / Ggl. C2 liegt neben Kapsel C1/2

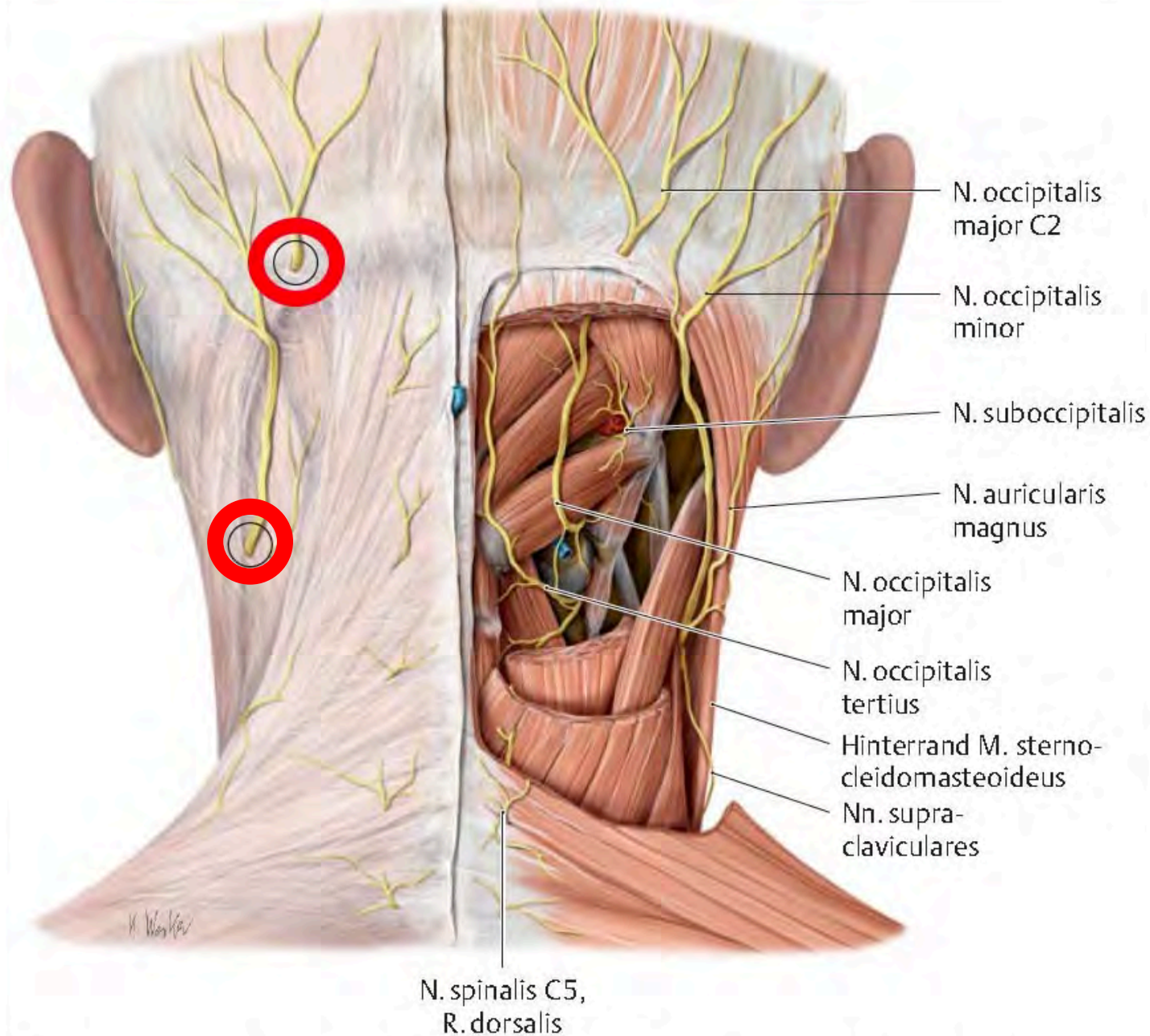


Plexus cervicalis (Rami ventrales)



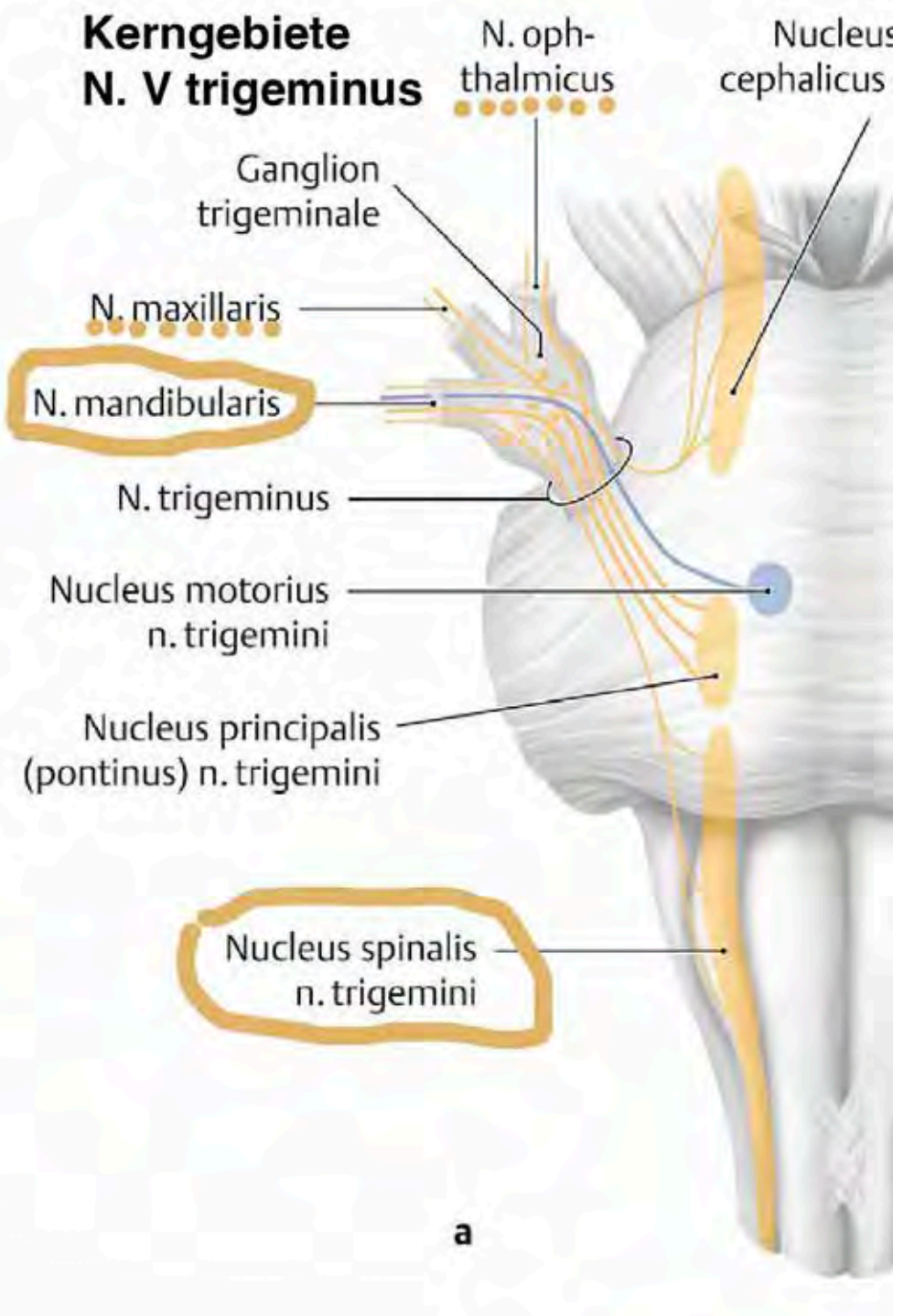
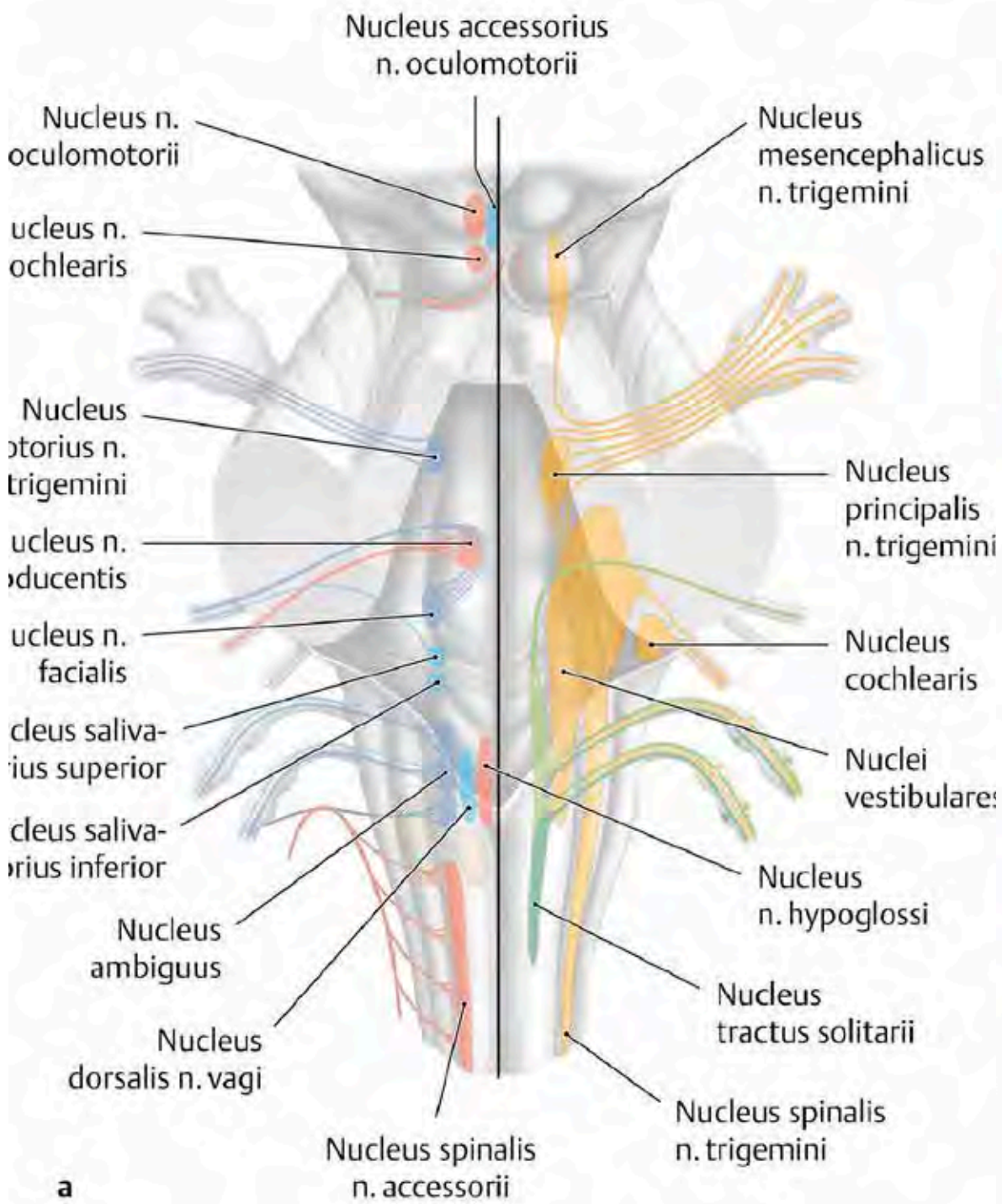
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 Nach Kendall 1979

d minor



○ klinisch wichtige Nervenaustrittsstellen: N. occipitalis major, N. occipitalis minor bzw. sensible Äste der Radix sensoria des Plexus cervicalis („Erb-Punkt“)

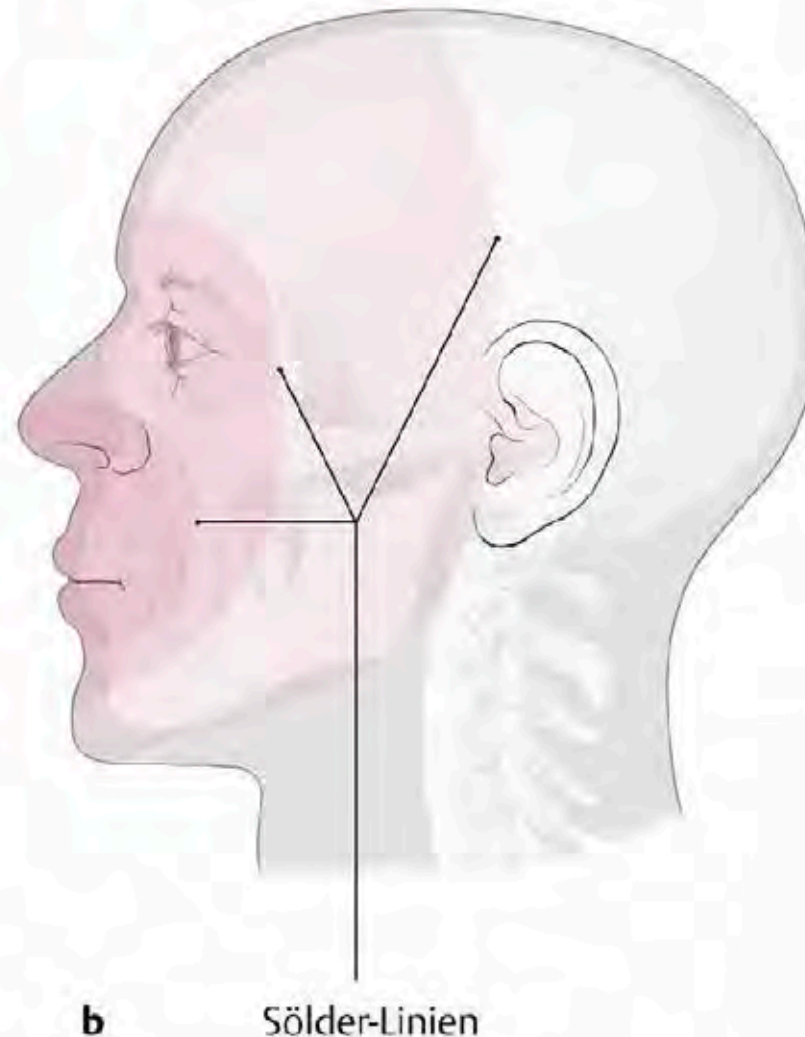
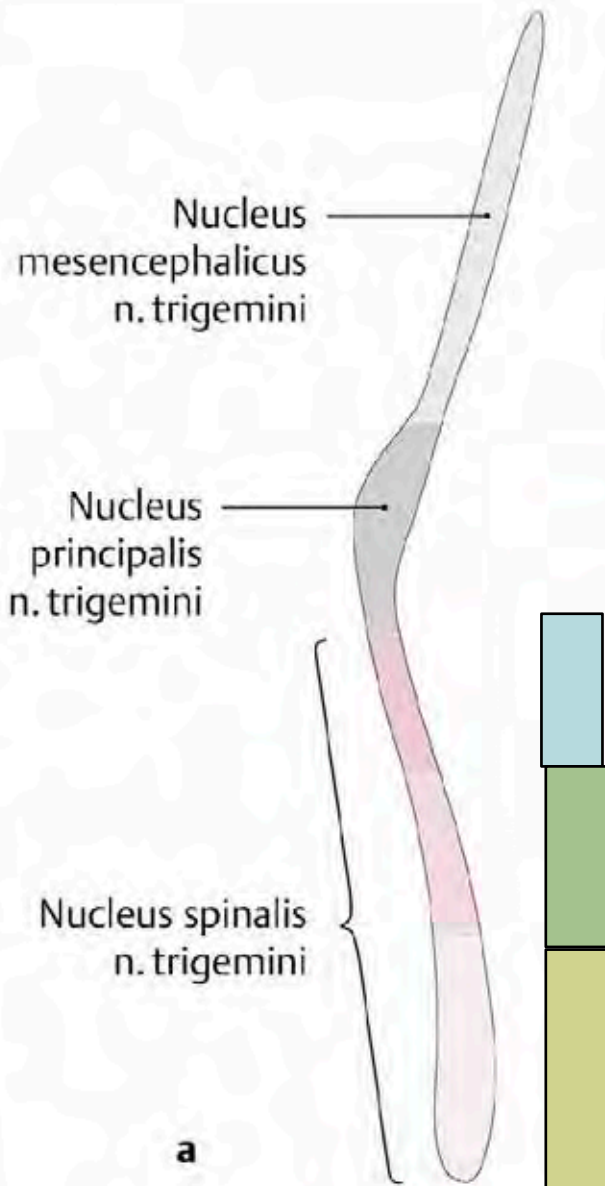
Aus © Böhni et al MM
Band 1 2014/22



Aspekte sensorischer Afferenzen

ergenz

- N. V:
Topik →
kaudal im
Ncl. spinalis
N. V



Aspe

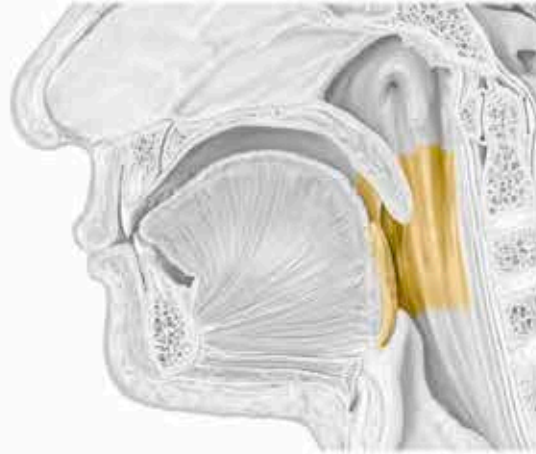
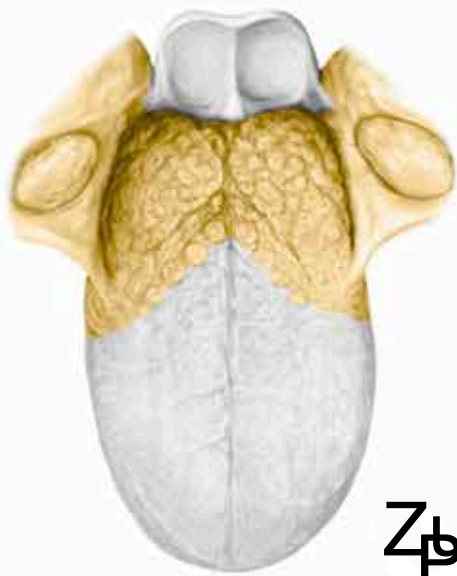


nzen



Aspekte sensorischer Afferenzen

N. IX und N. X: → Ncl.spinalis N. V



Zungenrund/Pharynx → Würgereflex
Pharynx/obere Luftwege → Rausporn etc.

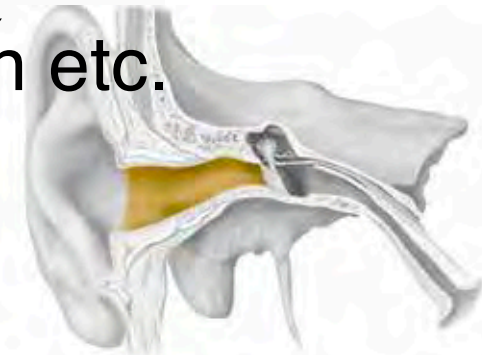
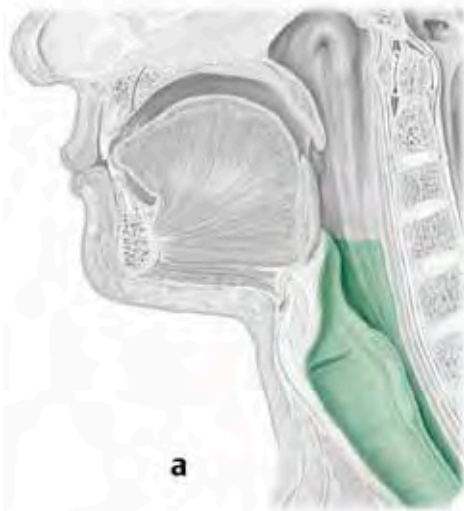
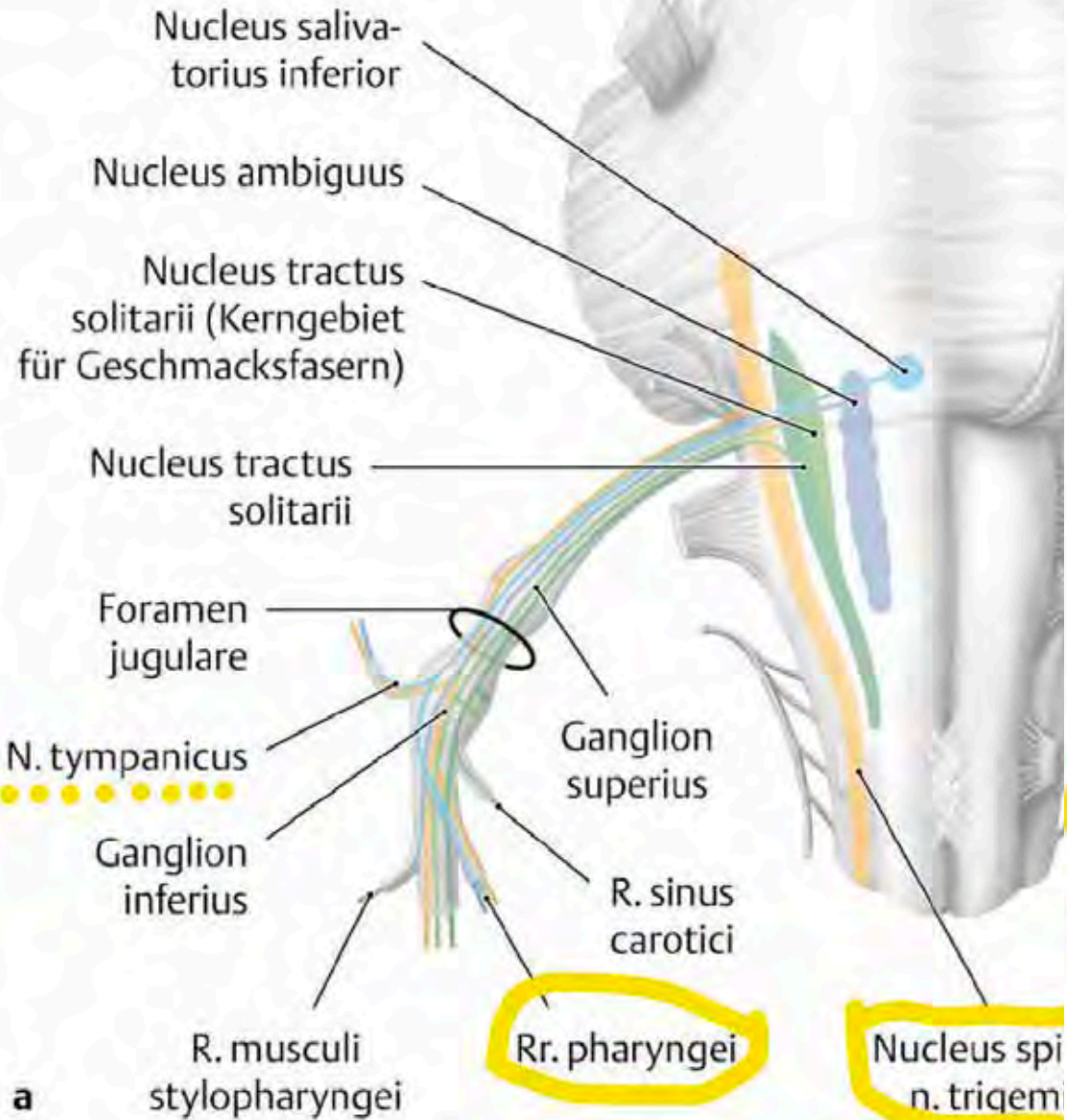
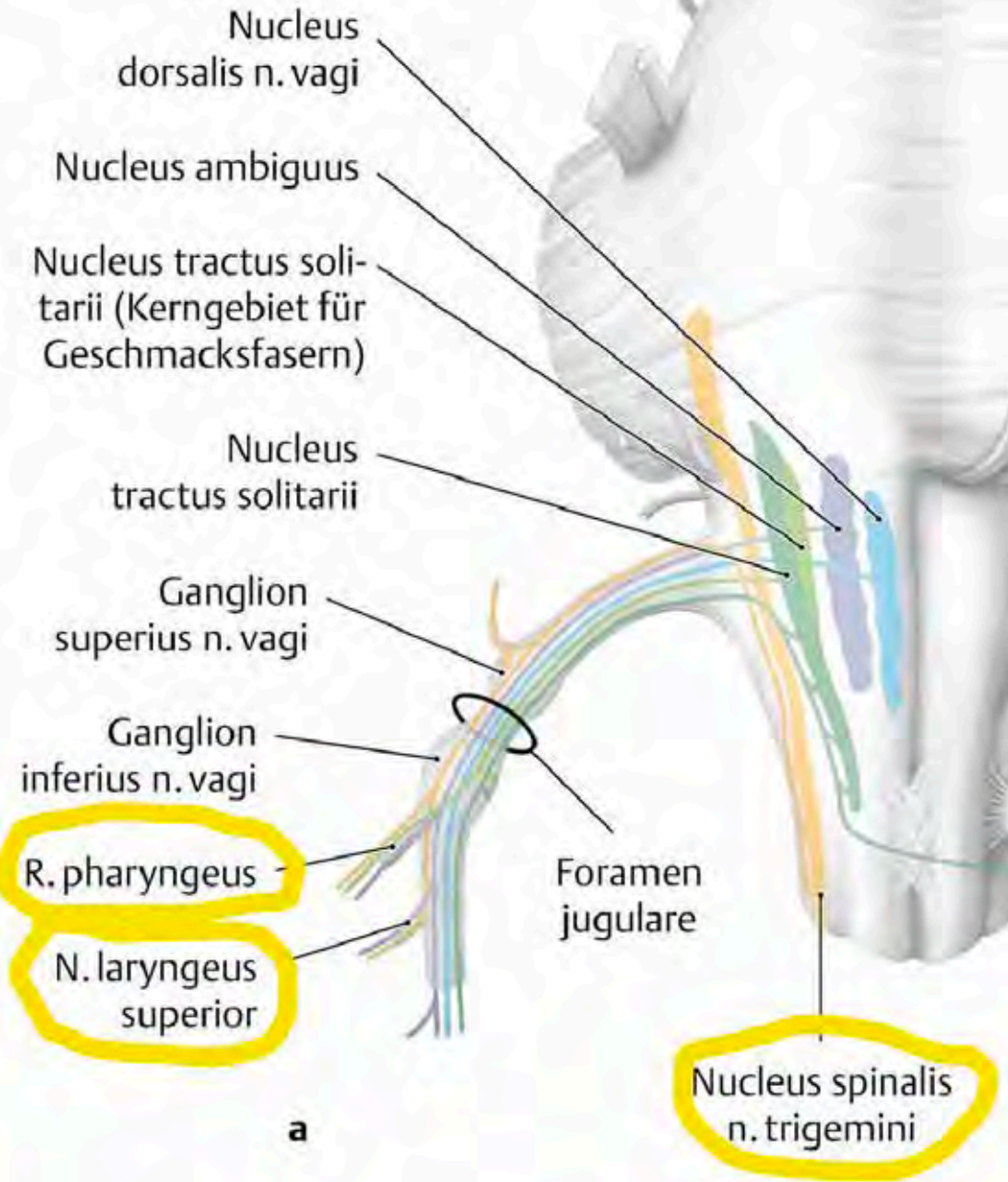


Abb. 4.67c

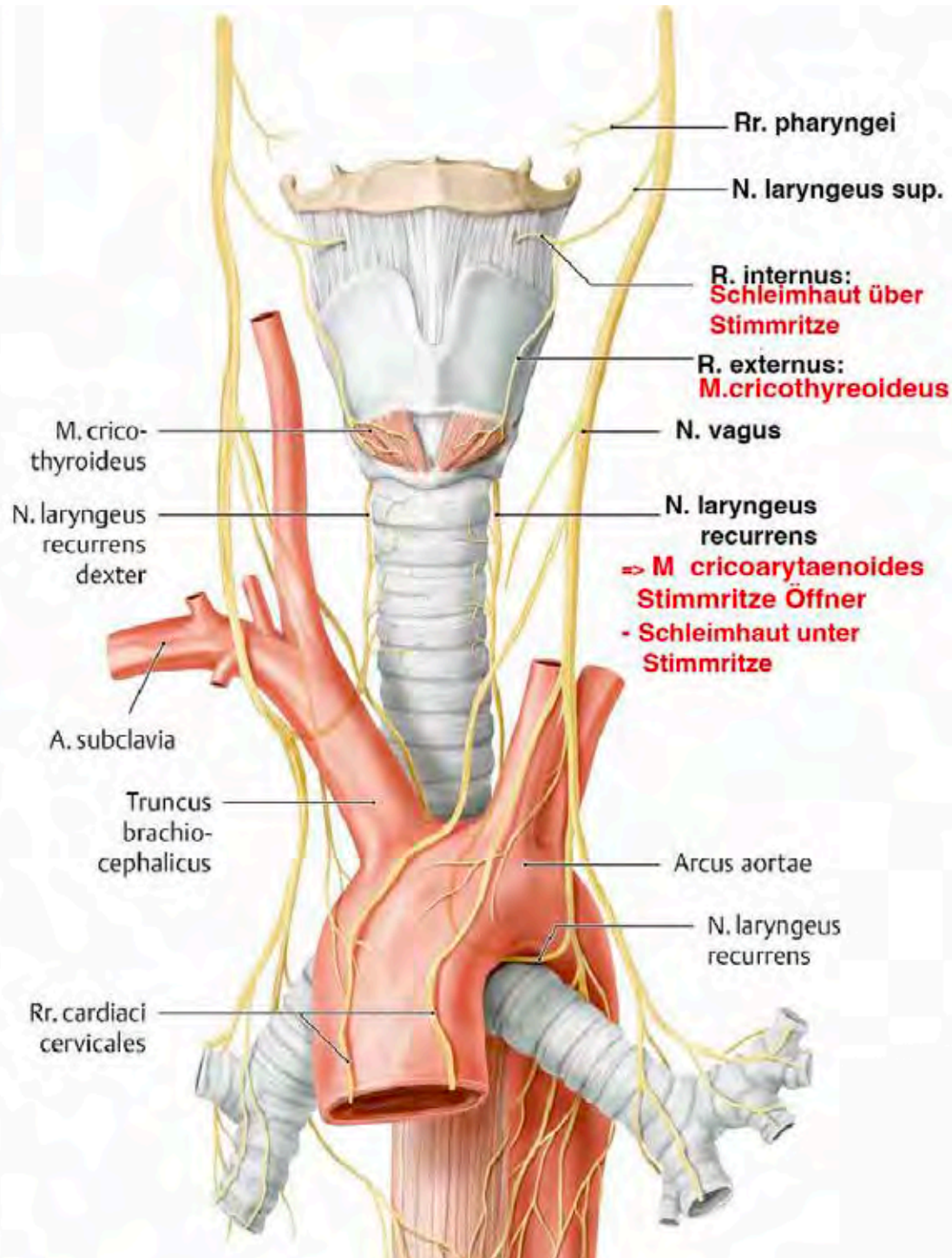
Kerngebiete N. IX glossopharyngeus



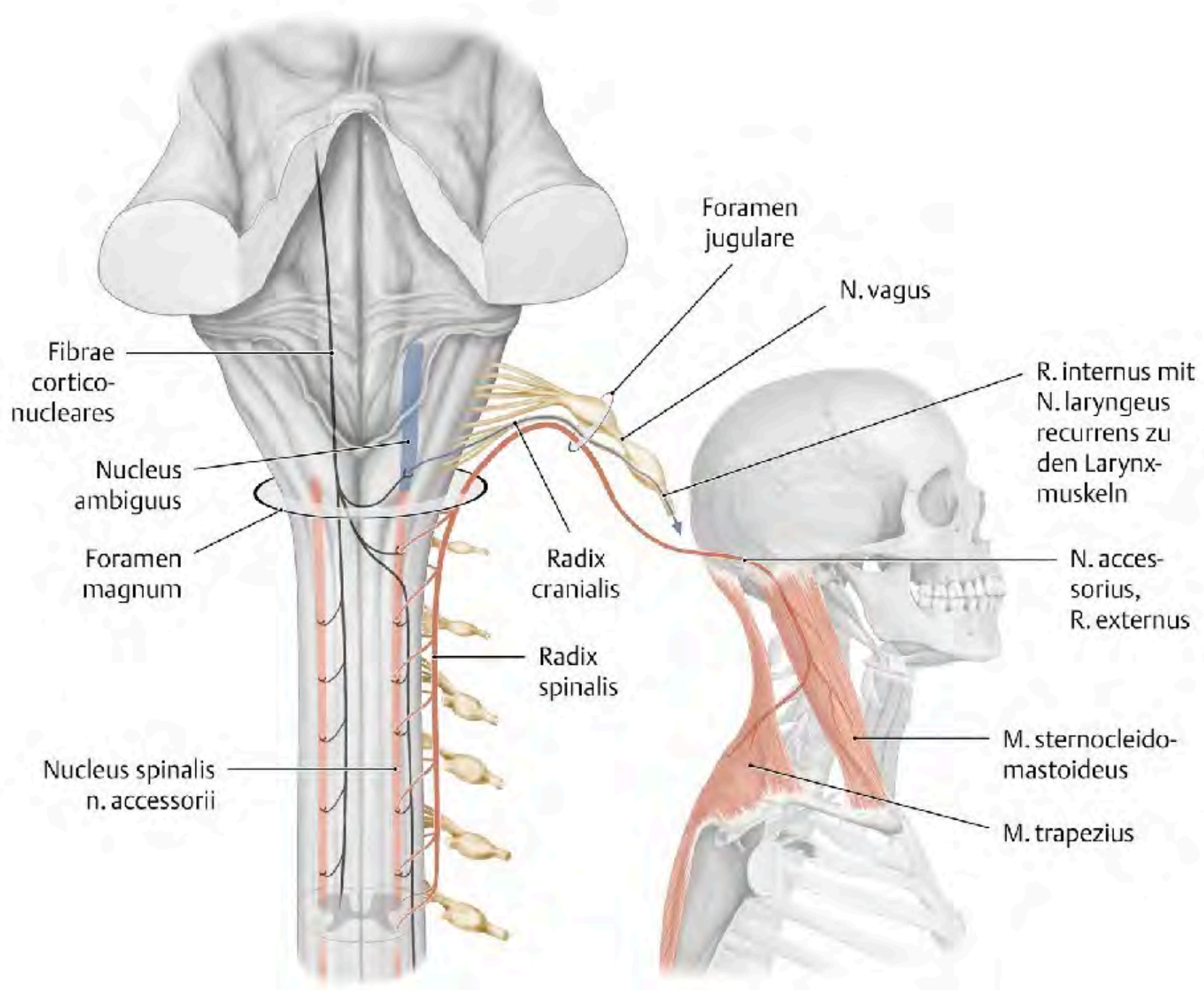
Kerngebiete N. X vagus



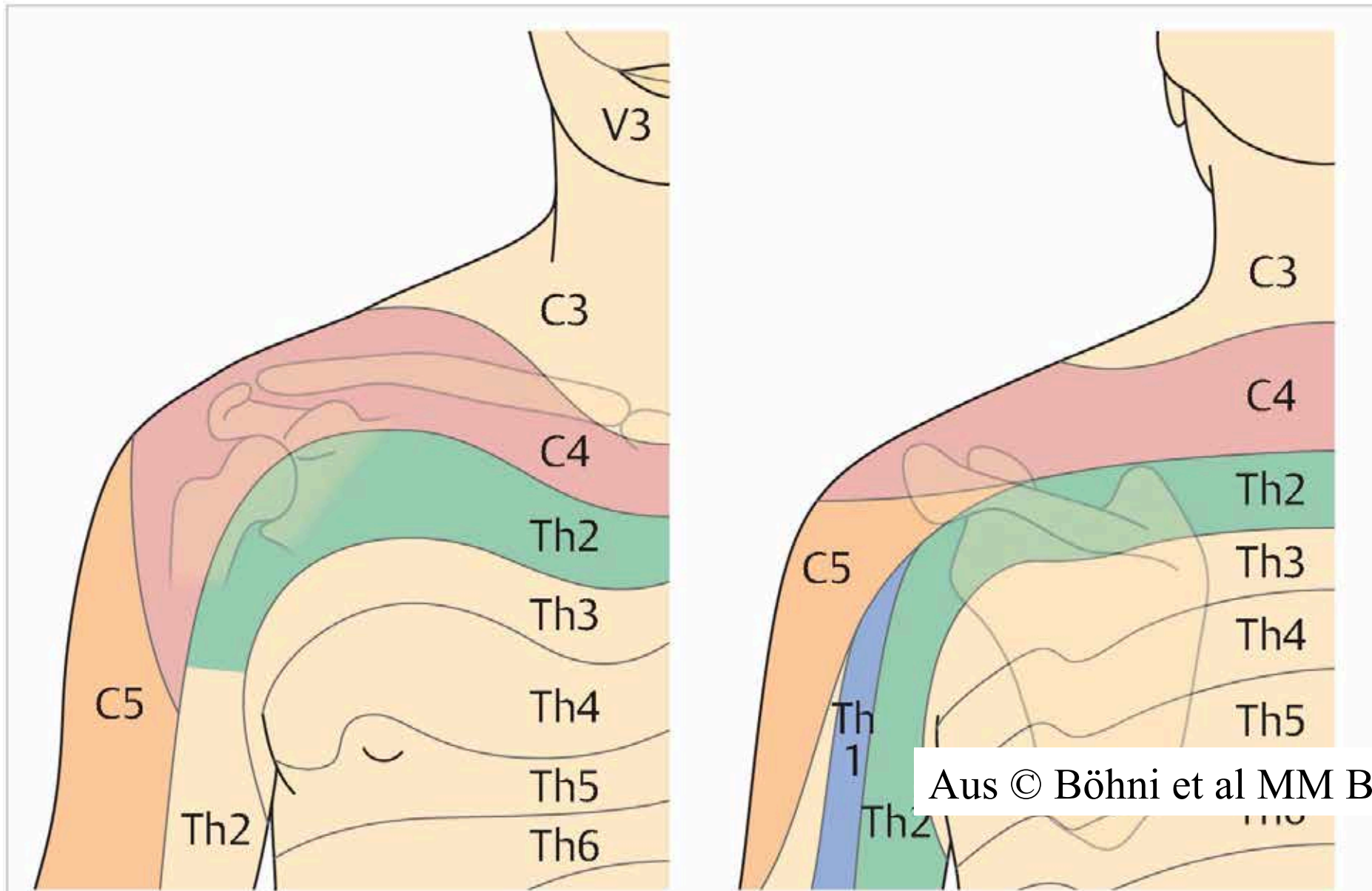
Aspekte N. X Nn.laryngei



- N. laryngeus superior
→ somatosensorisch
→ M. cricothyroideus
- N. laryngeus recurrens
→ alle Kehlkopfmuskeln
aber spez. *einzig*
Stimmritzenöffner = M. cricoarytaenoideus post.
→ somatosensorisch



Schmerzprojektion: Kopf? Schulter?



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2 Beschwerdesyndrome an der HWS

- Das **obere** zervikogene Schmerz- und Beschwerdesyndrom
 - Noziafferenzen C1-C3 – Segmente C0/1-C2/3 (C3/4)
 - Zervikozepale Symptome
 - Konvergenz mit trigeminalen und weiteren Hirnnervenafferenzen (zervikotrigeminale Konvergenz)
- Das **untere** zervikogene Schmerz- und Beschwerdesyndrom
 - Noziafferenzen C4-Th1
 - Einbezug zervikothorakaler Übergang
 - Nacken-Schulter-Arm-Beschwerden

Besten Dank !