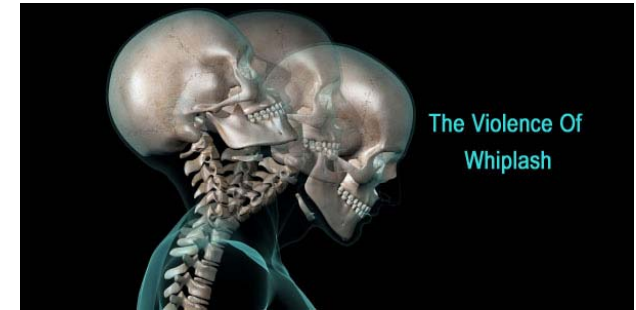
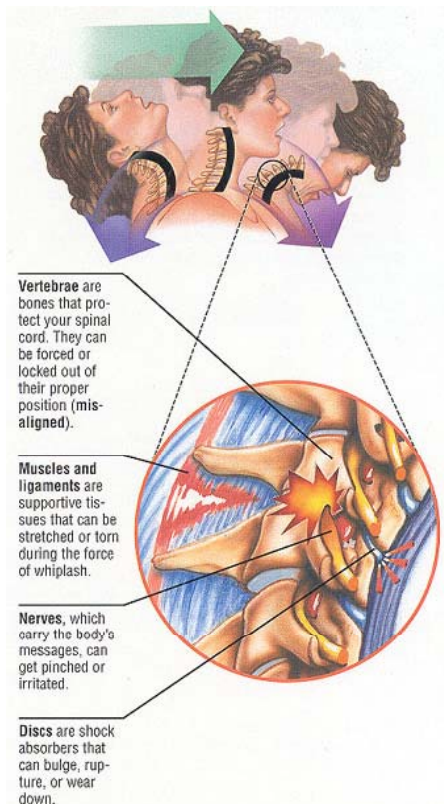


GMTTB Jahrestagung Konstanz 21. April 2012



Kollisionsbedingte HWS-Belastungen

Bildgebung bei HWS-Beschwerden - Sinn und Unsinn -



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Was sind HWS-Beschwerden - Definition

Lokal

Schmerzen

eingeschränkte Beweglichkeit, aktiv / passiv

druckdolente Muskeln/Sehnen/Gelenke

Projektionen

Arme - Schmerzen, Missempfindungen

Kopf - Schmerzen, Hör-, Seh-Störungen, Schwindel, etc.

Ganze WS - Lumbalgien



WP = Whiplash = „Schleudertrauma“ = HWS-Distorsionstrauma

WAD = Whiplash Associated Disorder = Symptomatik die dem Schleudertrauma angelastet wird

Beachte die klinische Symptomatik des WAD ist vielfältig und keineswegs spezifisch

Gibt es WP-spezifische HWS-Beschwerden ?

Verschiedene Klassifikationen der WAD
 [Whiplash Associated Disorder (=Symptomatik die dem Schleudertrauma angelastet werden kann)]

The Quebec Task Force classification of whiplash associated disorders

QTF classification grade	Clinical presentation
0	No complaint about neck pain No physical signs
I	Neck complaint of pain, stiffness or tenderness only No physical signs
II	Neck complaint Musculoskeletal signs including: Decreased range of movement Point tenderness
III	Neck complaint Musculoskeletal signs Neurological signs including: Decreased or absent deep tendon reflexes Muscle weakness Sensory deficits
IV	Neck complaint and fracture or dislocation

Sterling M. Spine 2004
 Sterling M. Manual Therapy 2004

Proposed new classification system for acute whiplash associated disorders (WAD)

Proposed classification grade	Physical and psychological impairments present
WAD 0	No complaint about neck pain No physical signs
WAD I	Neck complaint of pain, stiffness or tenderness only No physical signs
WAD IIA	Neck pain Motor Impairment Decreased ROM Altered muscle recruitment patterns (CCFT) Sensory Impairment Local cervical mechanical hyperalgesia
WAD II B	Neck pain Motor Impairment Decreased ROM Altered muscle recruitment patterns (CCFT) Sensory Impairment Local cervical mechanical hyperalgesia Psychological impairment Elevated psychological distress (GHQ-28, TAMPA)
WAD II C	Neck pain Motor Impairment Decreased ROM Altered muscle recruitment patterns (CCFT) Increased JPE Sensory Impairment Local cervical mechanical hyperalgesia Generalised sensory hypersensitivity (mechanical, thermal, BPPT) Some may show SNS disturbances Psychological Impairment Psychological distress (GHQ-28, TAMPA) Elevated levels of acute posttraumatic stress (IES)
WAD III	Neck pain Motor Impairment Decreased ROM Altered muscle recruitment patterns (CCFT) Increased JPE Sensory Impairment Local cervical mechanical hyperalgesia Generalised sensory hypersensitivity (mechanical, thermal, BPPT) Some may show SNS disturbances Psychological Impairment Psychological distress (GHQ-28, TAMPA) Elevated levels of acute posttraumatic stress (IES) Neurological signs of conduction loss including: Decreased or absent deep tendon reflexes Muscle weakness Sensory deficits
WAD IV	Fracture or dislocation

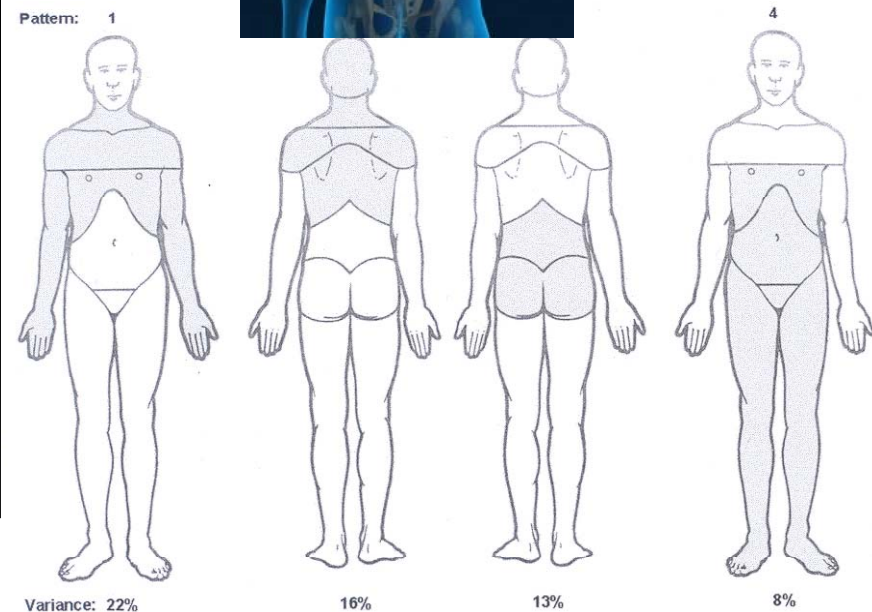
Gibt es WP-spezifische Beschwerden ?

...z.B. einen typischen Schmerz ??

TABLE 2 Prevalence of Pain Within 30 Days After Traffic Injury Reported by Saskatchewan Adults, 1994–1995 (N = 6481)

	Overall % (95% CI)	Percentage With Confined Pain (95% CI)
Posterior neck pain	86.2 (85.4–87.1)	0.43 (0.27–0.59)
Posterior shoulder pain	75.3 (74.3–76.4)	—
Head pain	72.0 (70.9–73.1)	0.35 (0.21–0.50)
Mid back pain	65.5 (64.4–66.7)	0.06 (0.00–0.12)
Lumbar pain	60.4 (59.2–61.6)	0.17 (0.07–0.27)
Buttock pain	42.2 (41.0–43.4)	0.11 (0.03–0.19)
Anterior neck pain	38.0 (36.8–39.2)	0.05 (0.00–0.10)
Anterior shoulder pain	35.9 (34.8–37.1)	—
Upper extremity pain	35.1 (33.9–36.3)	0.31 (0.17–0.44)
Lower extremity pain	27.5 (26.5–28.6)	0.68 (0.48–0.88)
Chest pain	18.9 (17.9–19.8)	0.05 (0.00–0.10)
Abdomen pain	15.9 (15.0–16.8)	—
Groin pain	1.8 (1.4–2.1)	—

Respondents were instructed to shade in or mark the areas of a body diagram where they feel pain after a recent traffic collision.



...nicht einmal das !

Hincapie et al. Whiplash is more than neck pain. JOEM 2010.

Was sind die Ursachen von HWS-Beschwerden und für deren Persistenz

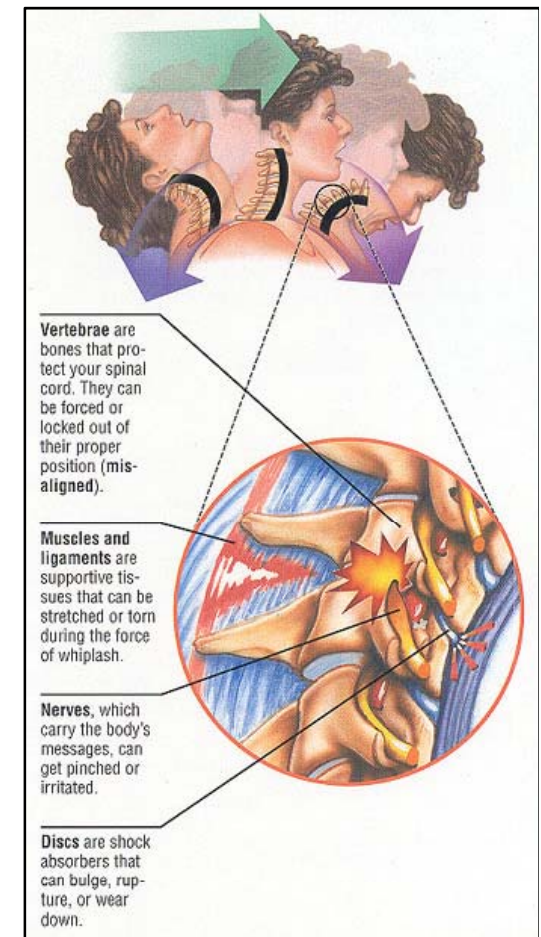
Pathophysiologische Modelle → was / wo / womit (Methode) suchen ?

... in the majority of injured people, a lesion cannot be established with current imaging technology.....

... lack of macroscopically identifiable tissue damage does not rule out the presence of painful lesions....

Involved mechanisms (rather hypothetical; aus Erklärungsnotstand):

- nociceptive processing
- stress responses
- psychosocial and sociocultural factors
- changes in neck muscles (atrophy, fatty infiltrates)



Sterling M, SPINE 2011 36; (25 Suppl):322
Elliott JM, SPINE 2011 36; (25 Suppl): 205

Bildgebungsmöglichkeiten

Konventionelle HWS-RX (ap/seitl./Dens)

- ossär, ligamentär indirekt (Fraktur, Dislokation, Instabilität)

Funktionsaufnahmen (ap/seitl./atlanto-dental)

- ossär, ligamentär indirekt (Dislokation, Instabilität)

CT (Computertomographie)

- ossär, ligamentär indirekt (Fraktur, Dislokation, Instabilität)

CT funktionell

- ossär, ligamentär indirekt (Dislokation, Instabilität)

MRT (Magnet Resonanz Tomographie)

- Weichteile (Bänder, Gelekkapseln, Muskeln)

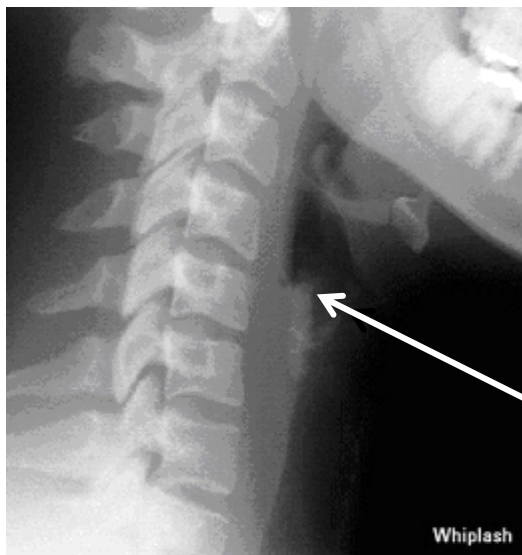
MRT funktionell

- ligamentär (Dislokation)

MRT speziell:

- Bänder, Muskeln, Gelenkkapseln

RX konventionell



Statische Aufnahmen ;
keine Korrelation der
bildgebenden Befunde mit
Den Beschwerden

Sogenannte „Fehlhaltung“ -
Hat keine pathologische/pathogenetische Bedeutung !

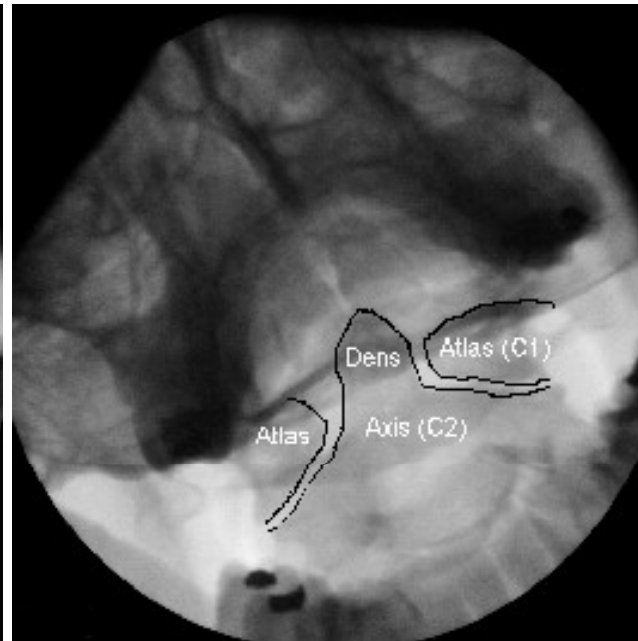
RX konventionell



Funktions-Aufnahmen,
Sog. „gehaltene Aufnahmen



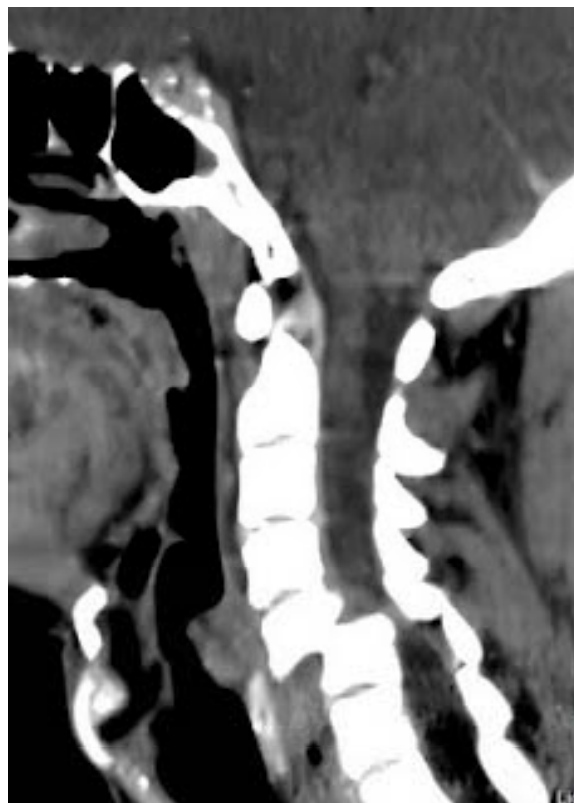
Keine Korrelation mit der
klinischen Symptomatik



Gehaltene Aufnahmen des
kranio-zervikalen Überganges
(„Funktions-Prüfung“ der
Ligamenta Alaria

→ keine zuverlässige Aussage

Computertomographie (CT)

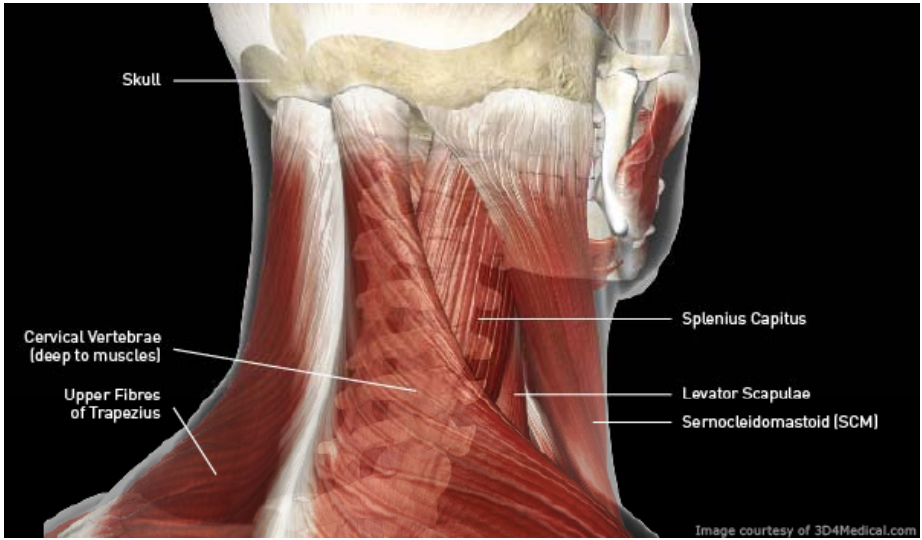


Beste Methode zur Frakturdetektion

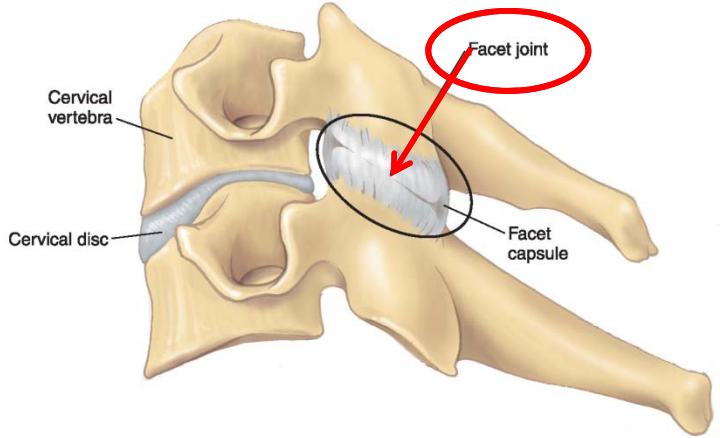
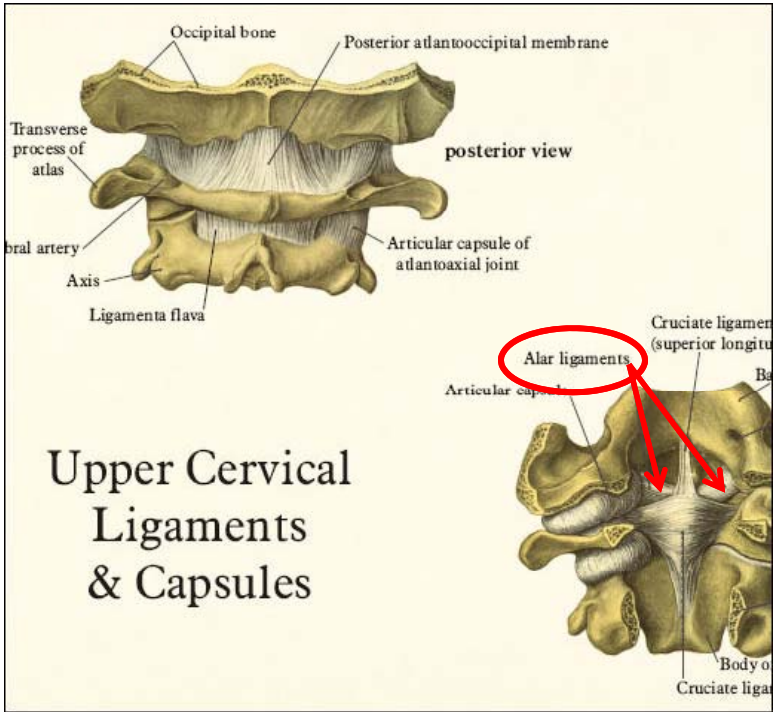
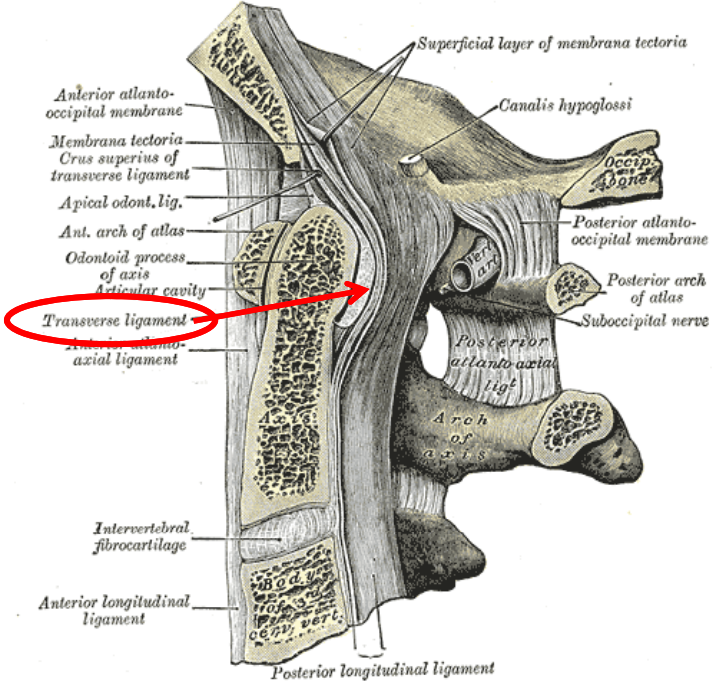
Bei WAD I und II (nach QTF) : keine Korrelation mit Klinik

Dynamische / funktionelle CT: keine reproduzierbaren Befunde

Magnet Resonanz Tomographie (MRT)



- Weichteile**
- Muskeln
 - Sehnen
 - Gelenke
 - Kapseln
 - Bänder



Pathomechanismus - ligamenta alaria transverse ligament

¹192 late WP patients (after 2-9 y)
30 controls
MRI of craniovertebral junction

Alar ligaments visualized in all 122; signal intensity > 45 cases high signal intensity grade 2 or 3 only in patients -> „permanent damage“

²90 acute WP patients &
90 matched healthy controls
- MR imaging

Thickness, signal intensity and contrast uptake of transverse ligament; blinded rating
> Thicker ligament in male patients; significant signal alteration
-> Small differences; not suited for individual diagnosis

³91 WAD 1-2 patients:
MRI acute & after 12 months
& 52 controls (neck pain, no injury)

Signal intensities in alar & transverse ligaments; blinded rating
> No difference between injured patients and controls
> No change from initial to follow-up

CONCLUSIONS

Signal changes in alar/transverse ligaments hardly explained by trauma
Special MR neck imaging not recommended in WP patients

¹Krakenes J, Kaale B. Acta Rad 2004; Neurorad 2002

²Ulrich E., Sturzenegger M. AJR 2011;5:961

³Vetti N,.. Krakenes J. AJNR 2011;10:1836

Pathomechanismus - zygapophysial (facet) joints

Lack of macroscopically identifiable tissue damage does not rule out the presence of painful lesions.

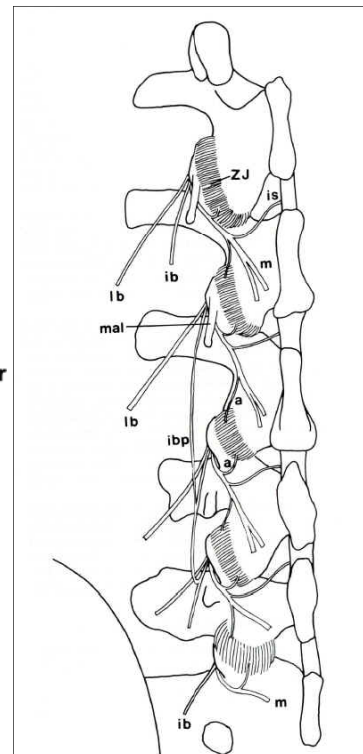
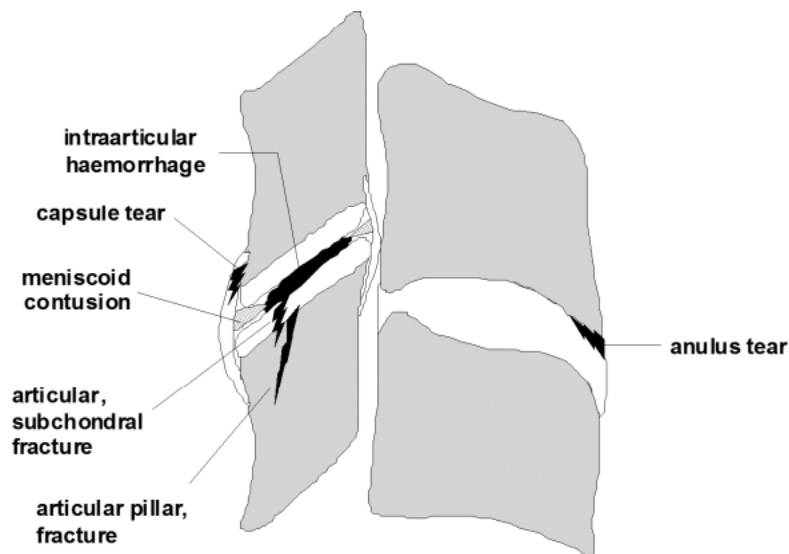
The best available evidence concerns zygapophysial joint pain

Postmortem studies

Biomechanical studies in volunteers and cadavers

Clinical studies

Facet joint as a cause of neck pain
(acute and chronic)



Selektive Facettgelenk-Denervation
(Thermokoagulation)

Problem:
Nur indirekter Hinweis
Sehr wenige Kandidaten
Sehr selektionierte Population

Boduk N. SPINE 2011 36 (25 Suppl): 194
Curatolo M. SPINE 2011 36 (25 Suppl): 309

Pathomechanismus - muskulär

Erklärt Latenz, Einfluss des Trainingszustandes, fehlende bildgebende Befunde

¹Beschleunigung- Reiz N. clunium –Anspannung Halsmuskeln – Kopfbewegung (supramaximale exzentrische Muskelkontraktion (Kontraktion bei gleichzeitige Längenzunahme) - Actin-Myosin-Zerfall – Entzündungsprozess (Schwellung, Oedem, Schmerz (auf Palpation, Dehnung) – Trigger points)

²38 acute WP patients & 38 matched controls
MRI evaluation of cervical muscle CSA
Clinically: Pain, EuroQuol,

blinded CSA measurements
> no difference between pat and controls
> women smaller CSA than men
> no correlation of CSA & clinical measures

³90 WP patients acute, 3 & 6 months
MRI cervical muscle CSA
Clinical: pain, EuroQuol, WDScore

blinded CSA measurements
> no changes over time
> women smaller CSA than men
> no correlation of CSA and clinical measures over time

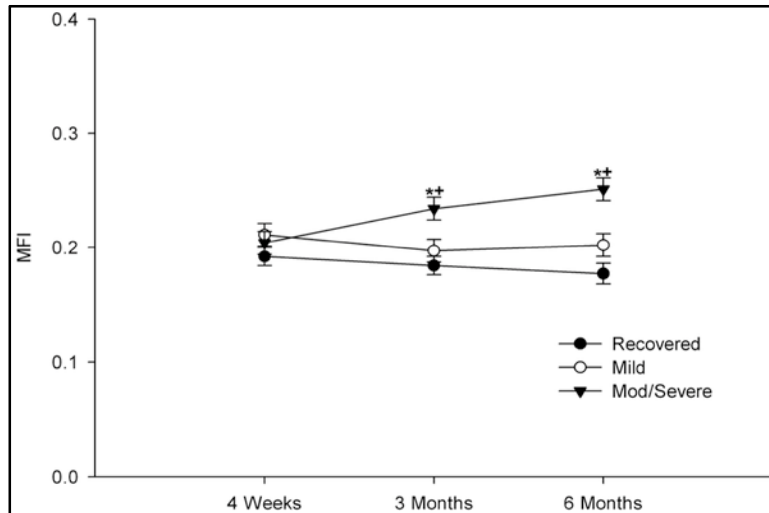
¹Meyer 1998, Baum 2001

²Ulbrich E,... Sturzenegger M. JMRI 2011;33:668

³Ulbrich E,... Sturzenegger M. JMRI 2012

Pathomechanismus – muskulär -2

44 WP patients
examined clinically and with MRI
at 4 weeks, 3 and 6 months



MFI (muscle fatty infiltrate) ; pain intensity (neck disability index (NDI), range of motion (ROM), PTSD (scale).

> Increased MFI in moderate/ severe patients compared to recovered/mild at 6 months
> Influence of NDI and PTSD

Causality ?

Mechanisms: inflammatory response ?
sympathetically mediated (PTSD)
disuse ?

Conclusion: - cervical muscle volumes do not have a major role in genesis of symptoms after whiplash
- changes in muscle structure may be more relevant

Korrelation Bildbefund - Symptome

100 consecutive acute & symptomatic WP patients
(QTS I & II)
100 age- & sex matched controls
MRI within 48 hrs
Blinded independent rating by 4 experienced readers

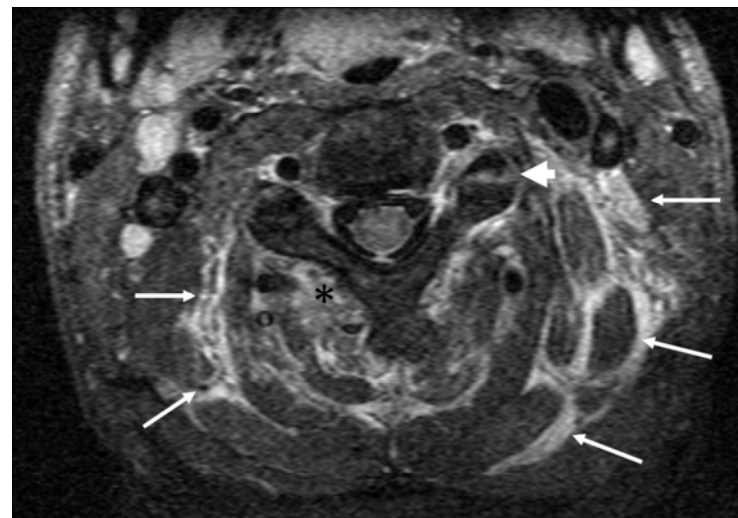
occult vertebral body & facet fractures
vertebral body and facet contusions
intervertebral disk herniations
ligamentum nuchae strains
ligamentum nuchae tears
muscle strains or tears
perimuscular fluid



Vertebral body fracture



Muscular hematoma *
Prevertebral hematoma
Epidural hematoma



Perimuscular hemorrhage
Muscle strain *
Facet asymmetry

Anderson S,..Sturzenegger M. Are there cervical spine findings at MR Imaging that are specific to acute symptomatic whiplash injury? A prospective controlled study. RADIOLOGY 2012; 252:567

Korrelation Bildbefund - Symptome

Accuracy of MR Imaging and interreader reliability : poor (ICC: 0.62)

With WP associated MR findings
occult fracture
muscle strain, muscle tear
perimuscular fluid

10 „WP specific findings“
were more frequent in patients
(507 observations; specificity 0.728; $P < .01$)
but were also regularly found in controls
(237 observations; sensitivity 0.328)

Table 3

Frequency of Findings

Finding	No. of Findings in Patients with Whiplash	No. of Findings in Control Subjects	OR	P Value	ICC
Occult vertebral body fracture	24	1	24.00*	<.01*	0.15
Vertebral body contusion	126	42	3.04	.10	0.27
Occult facet joint fracture	54	26	2.09	.10	0.00
Facet joint contusion	22	17	1.29	.62	0.00
Intervertebral disk herniation	101	101	0.99	.98	0.31
Ligamentum nuchae strain	20	30	0.65	.33	0.10
Ligamentum nuchae tear	10	4	2.50*	.14*	0.00
Muscle strain	95	14	6.86	<.01	0.69
Muscle tear and/or hematoma	9	0	5.69	<.01	0.27
Perimuscular fluid	46	2	23.0*	<.01*	0.59
All selected findings	507	237	2.13	<.01	0.62

Note.—ICC = intraclass correlation coefficient, OR = odds ratio.

* Calculated with Rao-Scott χ^2 test for concordance in patients versus control subjects, without covariate adjustment.

Conclusions

In all but the most severe grades of whiplash injury, MR findings are quite similar to those in age-matched control subjects without trauma.

It may be difficult to distinguish MR findings in lower grades of whiplash-associated injury from age-related degenerative changes.

Anderson S,..Sturzenegger M. Are there cervical spine findings at MR Imaging that are specific to acute symptomatic whiplash injury? A prospective controlled study. RADIOLOGY 2012; 252:567

Wann/Warum Bildgebung

- Ausschluss strukturelle Läsion
 - ossär
 - diskoligamentär
- Je kürzer die Beschwerdelatenz desto whs.
- Immer bei klaren neurolog. Symptomen oder Befunden
 - Sensibel oder motor. Defizite
 - Radikuläres Syndrom
 - Myelopathie Syndrom
- Erfassung Vorzustand
 - Degenerative Veränderungen
 - Enge Spinalkanal
 - Zufallsbefunde ± Relevanz





Peitschenschlagsyndrom

1 Halswirbelkörper, 2 Wirbel-Arterie, 3 Querfortsatz des Halswirbels
4 Anteile der tiefen Rückenmuskeln, 5 Dornfortsatz des Wirbels
6 Kleinste Muskelfaserrisse, 7 Kleine Bänderrisse

FAZIT

Schlecht definierte Symptomatik

Symptompathogenese:

- Viele Hypothesen
- Wenig fassbares

Radiologie:

- Keine zuverlässige Methodik
- Keine spezifischen Befunde

MRI im Einzelfall hilft kaum weiter