

JUDUL KETERAMPILAN KLINIS SISTEM MUSKULOSKELETAL

Penulis: dr. Dwi Prayogi, Sp.OT

I. Tingkat Kompetensi Keterampilan

Berdasarkan standar kompetensi dokter yang ditetapkan oleh KKI tahun 2020, maka tingkat kompetensi pemeriksaan muskuloskeletal adalah seperti yang tercantum dalam tabel 1.

Tabel 1. Tingkat kompetensi ketrampilan pemeriksaan fisik sistem muskuloskeletal (KKI, 2020)

No	Keterampilan	Tingkat Keterampilan
	<i>Pemeriksaan Fisik</i>	
1	Inspeksi <i>gait</i>	4
2	Inspeksi tulang belakang saat berbaring dan bergerak	4
3	Inspeksi tonus otot ekstremitas	4
4	Inspeksi sendi ekstremitas	4
5	Inspeksi postur tulang belakang/ pelvis	4
6	Inspeksi posisi scapula	4
7	Inspeksi fleksi dan ekstensi tulang belakang	4
8	Penilaian fleksi lumbal	4
9	Penilaian fleksi ekstensi, adduksi, abduksi dan rotasi panggul	4
10	Menilai atrofi otot	4
11	Penilaian ligamen krusiatatus dan kolateral lutut	4
12	Penilaian meniscus	3
13	Inspeksi postur dan bentuk kaki	4
14	Penilaian fleksi dorsal/plantar, inversi dan eversi kaki	4
15	<i>Palpation for tenderness</i>	4
16	Palpasi untuk mendeteksi nyeri diakibatkan tekanan vertical	4
17	Palpasi tendon dan sendi	4
18	Palpasi tulang belakang, sendi sakro-iliaka dan otot-otot punggung	4
19	<i>Percussion for tenderness</i>	4
20	Penilaian <i>range of motion (ROM)</i> sendi	4
21	Menetapkan ROM kepala	4
22	Tes fungsi otot dan sendi bahu	4
23	Tes fungsi sendi pergelangan tangan, metacarpal dan jari-jari tangan (Tanda Phallen, Tanda Tinnel, Tanda Luthy, Tanda Gower, dll)	4
24	Pengukuran panjang ekstremitas bawah	4

Keterangan:

Tingkat kemampuan 1 Mengetahui dan Menjelaskan

Tingkat kemampuan 2 Pernah Melihat atau pernah didemonstrasikan

Tingkat kemampuan 3 Pernah melakukan atau pernah menerapkan di bawah supervisi

Tingkat kemampuan 4 Mampu melakukan secara mandiri

II. Tujuan Belajar

1. Mahasiswa mampu menjelaskan konsep pengetahuan tentang pemeriksaan fisik sistem muskuloskeletal (jenis keterampilan pada tabel 1).
2. Mahasiswa mampu melakukan pemeriksaan fisik sistem muskuloskeletal dengan benar dan menginterpretasi hasil pemeriksaan fisik sistem muskuloskeletal

III. Prerequisite knowledge

Sebelum memahami konsep pemeriksaan fisik sistem muskuloskeletal, mahasiswa harus:

1. Memahami anatomi anggota gerak atas, anggota gerak bawah, dan tulang belakang
2. Memahami fisiologi anggota gerak atas, anggota gerak bawah, dan tulang belakang
3. Mengenal alat bantu diagnostik pada pemeriksaan fisik sistem muskuloskeletal
4. Memahami kelainan patologi pada sistem muskuloskeletal

IV. Kegiatan Pembelajaran

Pembelajaran dilakukan dalam tahapan sebagai berikut:

Tahapan pembelajaran	Lama	Metode	Pelaksana/ Penanggung Jawab
Praktikum Keterampilan Klinik	2 x 100 menit	Demonstrasi/audiovisual, Role play, feedback	Dosen Pakar
Praktikum keterampilan klinik mandiri	Tentative	Role play dengan Asisten Laboratorium (Aslab)	Aslab
Evaluasi	Tentative	Evaluasi dilakukan pada akhir semester dalam bentuk OSCE	Tim OSCE

V. Sumber belajar

Fisiologi Sistem Muskuloskeletal

Reaksi inflamasi ditandai oleh serangkaian proses biokimia sebagai respon terhadap injuri akibat trauma atau tindakan pembedahan, metabolik atau proses infeksi. Tanda – tanda klinis inflamasi (*Cardinal sign*) meliputi erythema (rubor), oedema lokal (tumor), peningkatan temperature dalam jaringan (calor), dan nyeri (dolor).

Vasodilatasi lokal yang mengakibatkan ekstrasvasasi cairan menuju ruang ekstra selular dan ekstra vascular, serta terhambatnya aliran system limfatik berperan dalam terjadinya erythema, oedema local dan peningkatan temperatur dalam jaringan. Tanda klinis inflamasi yang keempat berupa nyeri timbul sebagai akibat pembengkakan jaringan yang secara mekanik menekan jaringan lunak sekitarnya dan iritasi kimia yang ditimbulkan oleh mediator inflamasi pada reseptor saraf sensoris.

Fase inflamasi akut berlangsung segera setelah terjadi injuri dan berlangsung selama 24 sampai 48 jam meskipun dalam beberapa kondisi dapat berlangsung sampai 3 minggu.

Fase proliferaatif dapat terjadi pada awal fase inflamasi, meskipun sebagian besar terjadi pada hari ke-21 paska injuri.

Fase remodeling atau formasi matriks mulai terjadi pada minggu ketiga dan dapat berlangsung selama dua tahun.

Panduan Tata Cara Pemeriksaan Sistem Muskuloskeletal

Anamnesis dan pemeriksaan klinis merupakan serangkaian proses yang sistematis yang perlu dipelajari, dilatih dan diterapkan dalam rangka mendapatkan diagnosis dan tata laksana yang tepat. Proses ini memerlukan waktu dan latihan yang berulang-ulang.

Dengan memperhatikan kondisi pasien pada saat masuk ke dalam ruang pemeriksaan dapat memberikan gambaran secara umum tentang kondisi pasien dan kadang-kadang pemeriksa dapat mengetahui kepribadian pasien. Memperkenalkan diri kepada pasien, menanyakan nama pasien dan pengantar, serta hubungan antara pasien dan pengantar

Dokter harus mendengarkan dan memperhatikan setiap perkataan pasien dan mendokumentasi setiap pernyataan pasien yang berhubungan dengan kondisi pasien. Dokter sebaiknya mengarahkan alur pembicaraan dengan menghindari pertanyaan yang mengarahkan pasien.

Dalam pemeriksaan klinis, dokter senantiasa menjelaskan setiap pemeriksaan yang akan dilakukan dan mengapa pemeriksaan tersebut perlu dilakukan untuk mengurangi kecemasan pasien. Pemeriksaan klinis terhadap pasien harus dilakukan secara gentle tanpa menimbulkan nyeri dan dalam kondisi yang nyaman bagi pasien.

Anamnesis meliputi keluhan utama, riwayat seputar keluhan utama, riwayat sebelumnya, riwayat pengobatan, riwayat keluarga, riwayat sosial dan pekerjaan, riwayat pribadi, dan harapan pasien terhadap kondisinya.

Pemeriksaan klinis meliputi :

1. Pemeriksaan kondisi umum

Meliputi pemeriksaan pasien secara menyeluruh. Keadaan umum, status mental, ada tidaknya anemia, jaundice, cyanosis, clubbing, perubahan kulit dan kuku, pedal oedema, demam, deformitas pada sendi dan tulang yang multiple dan manifestasi klinis yang lain.

2. Pemeriksaan status lokalis

Meliputi pemeriksaan

- Inspeksi (Look),
- Palpasi (Feel),
- Movement (gerak), meliputi pemeriksaan gerak aktif dan pasif, pengukuran ruang lingkup gerak sendi (Range of Movement) dengan menggunakan goniometer
- Pengukuran dengan alat bantu
- Status neurovascular

Pemeriksaan pada kondisi bengkak atau swelling, meliputi :

- Lokasi
- Ukuran
- Warna



- Suhu
- Tenderness
- Bentuk
- Permukaan; halus, irregular, berbungkul
- Tepi; tegas, tidak tegas
- Konsistensi; lunak, padat kenyal, keras
- Redusibilitas
- Fluktuasi
- Pulsatile
- Transiluminasi
- Hubungan dengan jaringan sekitar
- Fiksasi terhadap tulang atau kulit
- Pembesaran Kelenjar Getah Bening regional
- Status neurovaskular, sendi dan tulang

Pemeriksaan pada kondisi Ulkus, meliputi :

- Lokasi
- Ukuran dan bentuk
- Warna

- Suhu
- Tenderness
- Dasar luka
- Tepi ulkus
- Kedalaman ulkus
- Discharge
- Pembesaran Kelenjar Getah Bening regional
- Status neurovaskular, sendi dan tulang

Pada kasus trauma, pemeriksaan klinis mengacu pada kaidah-kaidah di dalam **Advanced Trauma Life Support (ATLS)**, yang mengidentifikasi dan secara simultan melakukan penatalaksanaan secara dini pada kondisi atau keadaan yang mengancam nyawa.

Table 2.1: ATLS® approach to managing the trauma patient

Primary survey

1. Airway with cervical spine control
2. Breathing
3. Circulation with hemorrhage control
4. Disability
5. Exposure
6. Re-evaluation
7. Adjuncts to the primary survey

Secondary survey

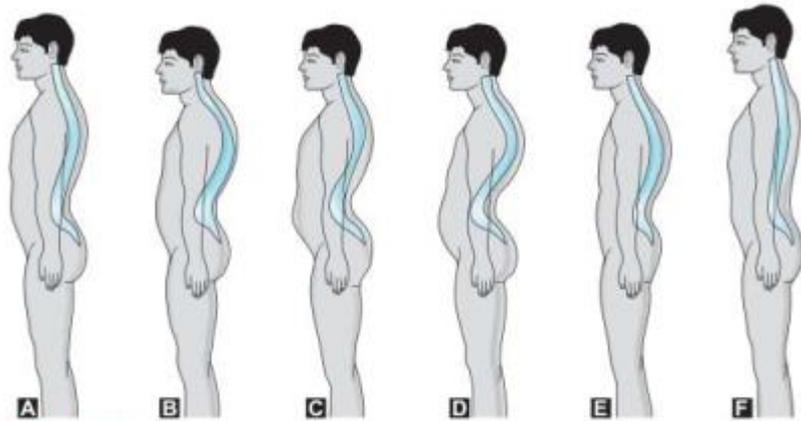
1. History
2. Examination
3. Adjuncts to the secondary survey

Secara umum, pemeriksaan sistem muskuloskeletal mengikuti pola sebagai berikut :

1. Inspeksi (Look)
2. Palpasi (Feel)
3. Movement, meliputi gerak aktif dan pasif
4. Pemeriksaan klinis khusus, meliputi pemeriksaan ligament, pemeriksaan status neurologis
5. Pemeriksaan Tambahan, meliputi radiografi, ultrasound, CT scan, MRI, Doppler, pengukuran tekanan kompartemen

Anatomi Tulang Belakang / Spine

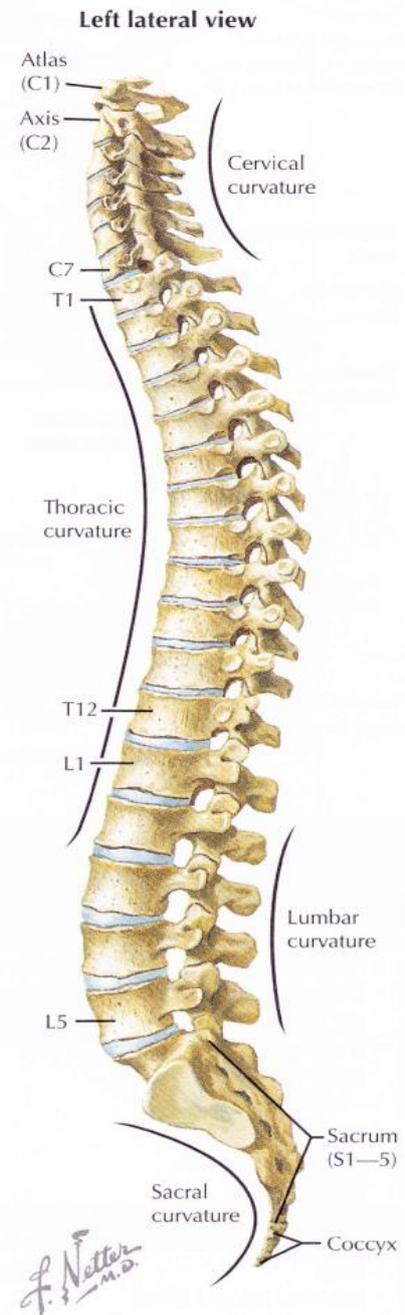
Pada orang dewasa, susunan tulang belakang memiliki empat kurva pada bidang sagital yang menentukan keseimbangan dalam fungsi tulang belakang saat bergerak dan menahan beban tubuh. Keseimbangan dalam bidang sagital tulang belakang dapat dievaluasi dengan menarik garis lurus yang tegak lurus terhadap posisi horisontal dari vertebra cervicalis tujuh (C7) melalui sisi posterior dari vertebra sacral satu (S1).



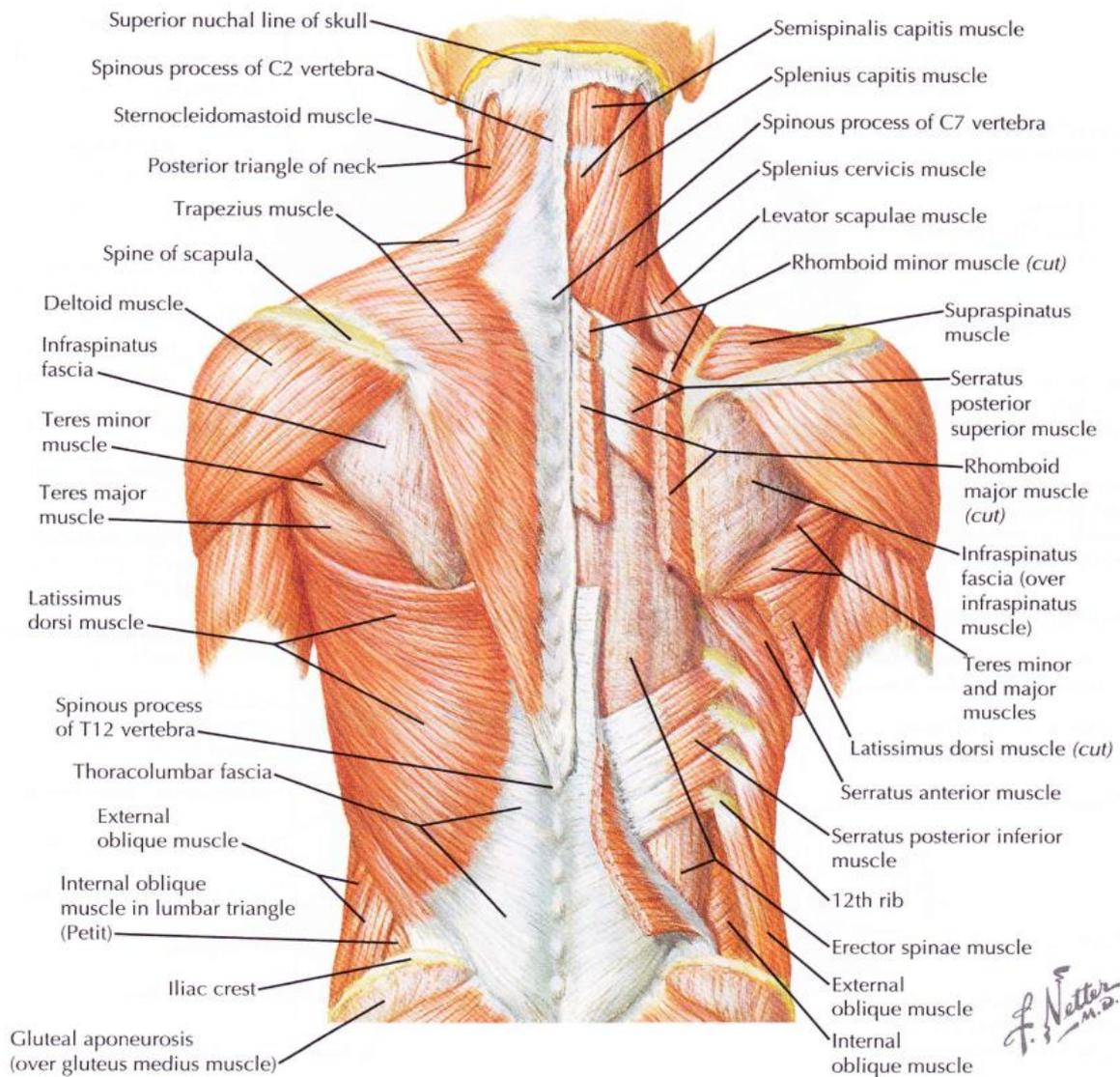
Figs 10.1A to F: Various types of posture: (A) Physiologic, (B) Thoracic hyperkyphosis, (C) Lumbar hyperlordosis, (D) Thoracic hyperkyphosis and lumbar hyperlordosis, (E) Total kyphosis, (F) Flat back

Gambar 1. Berbagai Tipe postur Tulang Belakang

GENERAL INFORMATION	
<ul style="list-style-type: none"> • 33 Vertebrae: 7 cervical, 12 thoracic, 5 lumbar, 5 sacral (fused), 4 coccygeal (fused) • Vertebrae form a functional column • 3 column theory (Denis): spine is divided into 3 columns <ul style="list-style-type: none"> ◦ Anterior: ALL & anterior $\frac{2}{3}$ of vertebral body/annulus ◦ Middle: PLL & posterior $\frac{1}{3}$ of vertebral body/annulus ◦ Posterior: Pedicles, lamina, spinous process, and ligaments • Spinal curves: normal curves <ul style="list-style-type: none"> ◦ Cervical lordosis ◦ Thoracic kyphosis ◦ Lumbar lordosis ◦ Sacral kyphosis 	
Spinal Regions	
Cervical	C1-C2: unique bones allow stabilization of occiput to spine and rotation of head. Motion: rotation and flexion/extension.
Thoracic	Relatively stiff due to costal articulations. Motion: rotation. Minimal flexion/extension.
Thoraco-lumbar	Facet orientation transitions from semicoronal to sagittal. Segments are mobile. Most common site of lower spine injuries.
Lumbar	Largest vertebrae. Common site for pain. Houses cauda equina. Motion: flexion/extension. Minimal rotation.
Sacrum	No motion. Is center of pelvis.
Vertebrae	
<ul style="list-style-type: none"> • Uniquely shaped bones that support the axial musculature and protect the spinal cord and nerve roots 	
Body (centrum)	Has articular cartilage on both superior & inferior surfaces. Articulates with intervertebral discs & gets larger distally.
Arch	Made up of pedicles and lamina. Develops from 2 ossification centers that fuse. Failure to fuse occurs in spina bifida. It forms the vertebral canal for the spinal cord.
Processes	Spinous: ligament attachment site. Transverse: rib (T-spine) and ligament attachment site.
Foramina	Vertebral: spinal cord/cauda equina. Neural: nerve roots exit via here.
LEVEL	CORRESPONDING STRUCTURE
C2-3	Mandible
C3	Hyoid cartilage
C4-5	Thyroid cartilage
C6	Cricoid cartilage
C7	Vertebral prominens
T3	Spine of scapula
T7	Xyphoid, tip of scapula
T10	Umbilicus
L1	Conus medullaris (end of cord)
L3	Aorta bifurcation
L4	Iliac crest

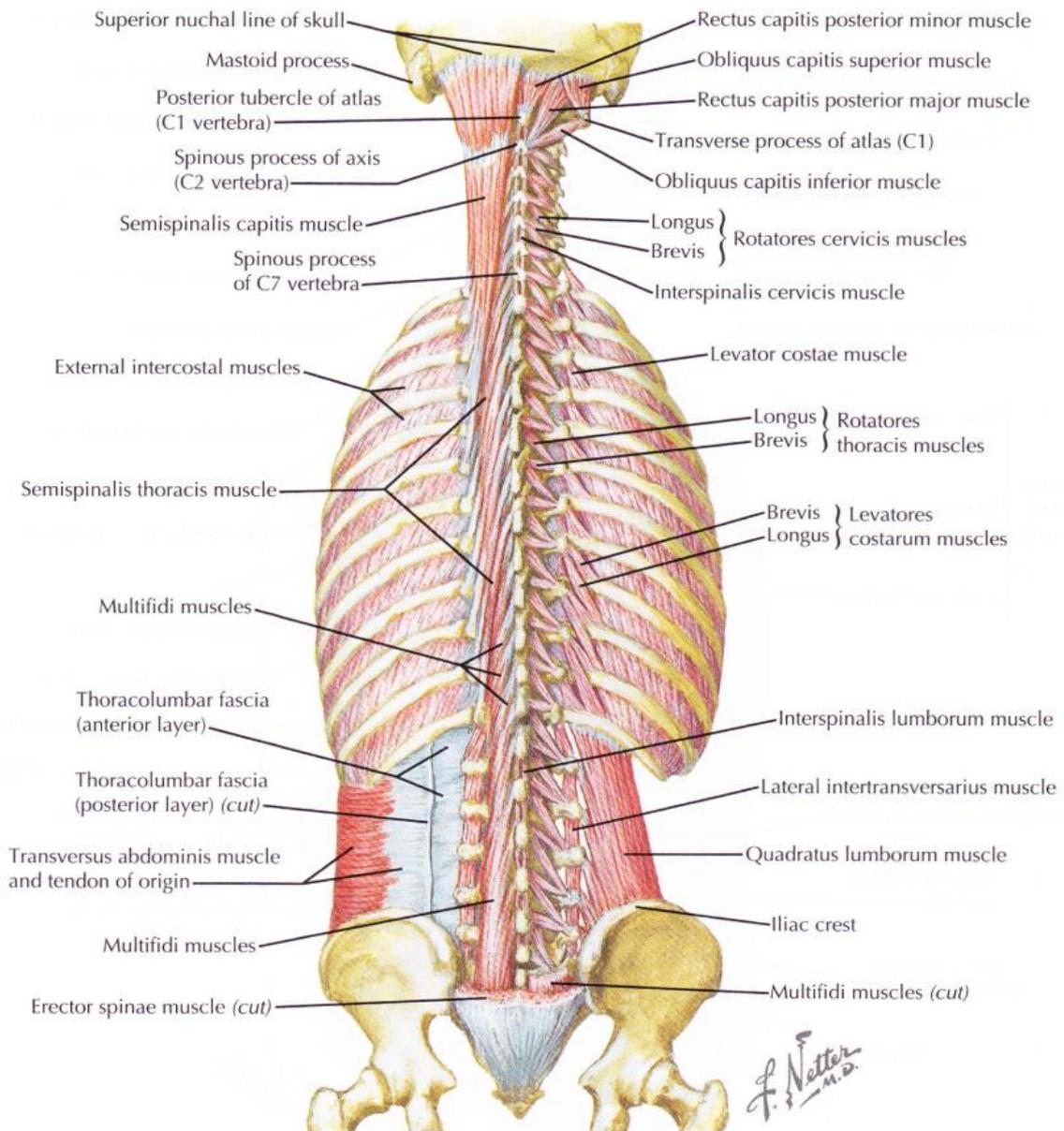


Gambar 2. Susunan Tulang Belakang

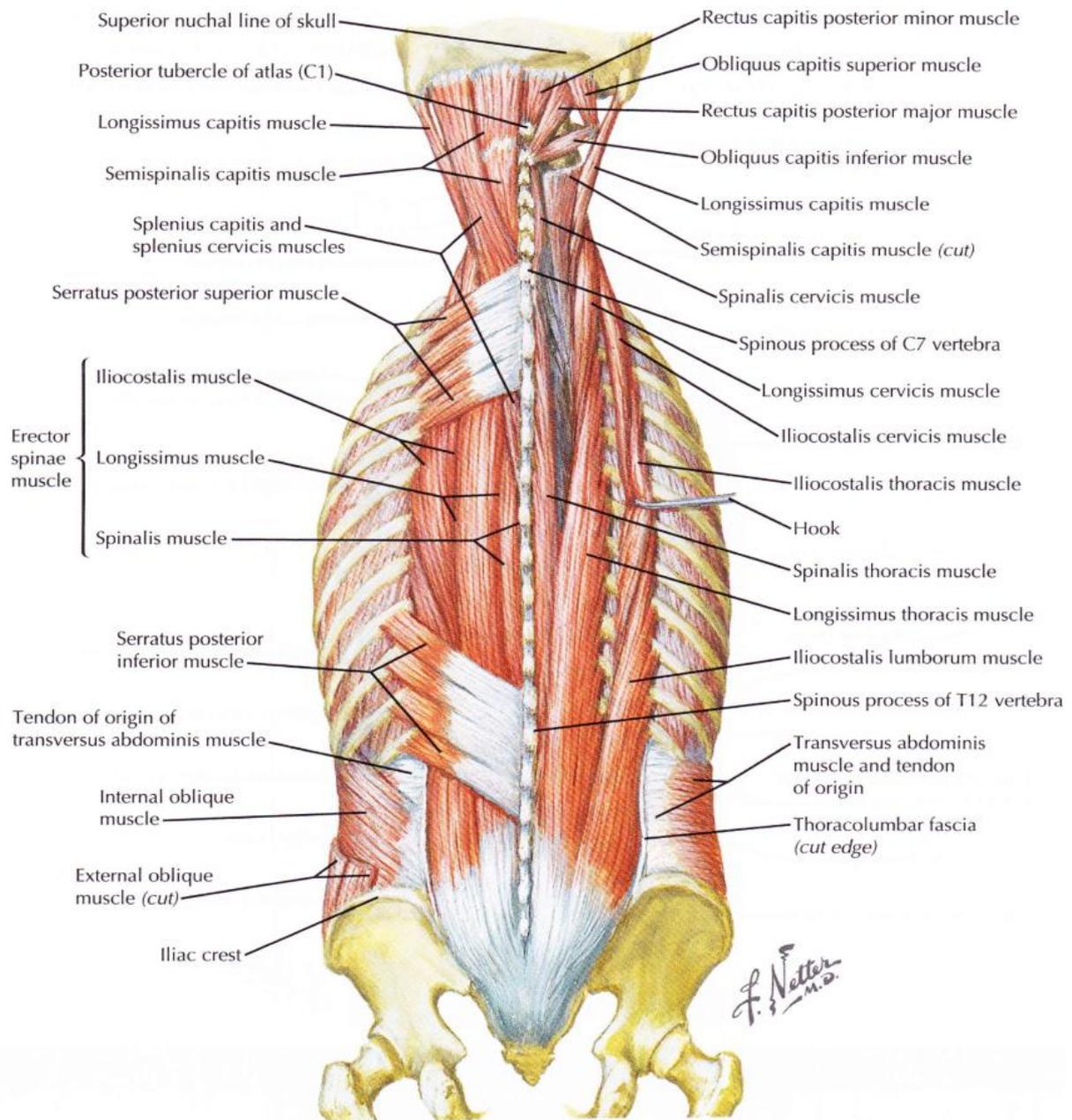


MUSCLE	ORIGIN	INSERTION	ACTION	NERVE
SUPERFICIAL (EXTRINSIC)				
Trapezius	Spinous process C7-T12	Clavicle; scapula (spine, acromion)	Rotate scapula	CN 11
Latissimus dorsi	Spinous process T6-S5	Humerus	Extend, adduct, IR arm	Thoracodorsal
Levator scapulae	Transverse process C1-4	Scapula (medial)	Elevate scapula	Dorsal scapular, C3, C4 (dorsal rami)
Rhomboid minor	Spinous process C7-T1	Scapula (spine)	Adduct scapula	Dorsal scapular
Rhomboid major	Spinous process T2-T5	Scapula (medial border)	Adduct scapula	Dorsal scapular
Serratus posterior superior	Spinous process C7-T3	Ribs 2-5 (upper border)	Elevate ribs	Intercostal n. (T1-4)
Serratus posterior inferior	Spinous process T11-L3	Ribs 9-12 (lower border)	Depress ribs	Intercostal n. (T9-12)

Gambar 3. Susunan otot tulang belakang Bagian Superfisial



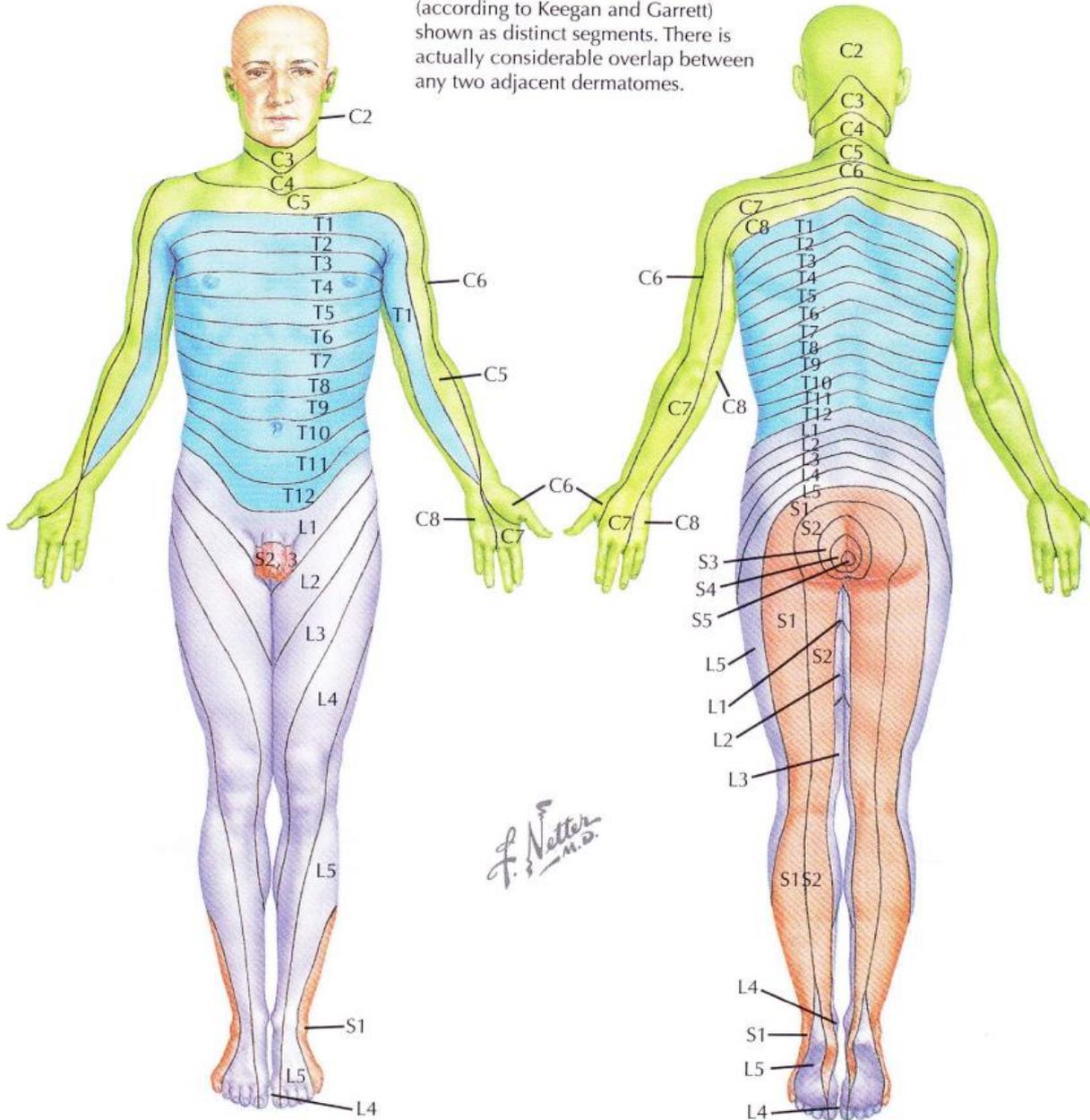
MUSCLE	ORIGIN	INSERTION	ACTION	NERVE
DEEP (INTRINSIC)				
Deep Layers: Transversospinalis Group				
Semispinalis capitus	Transverse process T1-6	Nuchal ridge	Extend head	Dorsal primary rami
Semispinalis (C&T)	Transverse process	Spinous process	Extend, rotate opposite side	Dorsal primary rami
Multifidus (C2-S4)	Transverse process	Spinous process	Flex laterally, rotate opposite	Dorsal primary rami
Rotatores	Transverse process	Spinous process + 1	Rotate superior vertebrae opposite	Dorsal primary rami
Levator costarum	Transverse process	Brevis: rib - 1 Longus: rib - 2	Elevate rib during inspiration	Dorsal primary rami
Interspinales	Spinous process	Spinous process + 1	Extend column	Dorsal primary rami
Intertransversarii	Tranverse process	Transverse process + 1	Laterally flex column	Dorsal primary rami



MUSCLE	ORIGIN	INSERTION	ACTION	NERVE
DEEP (INTRINSIC)				
Superficial Layer: Spinotransverse Group				
Splenius capitis Splenius cervicis	Ligamentum nuchae Spinous process T1-6	Mastoid & nuchal line Transverse process C1-4	Both: laterally flex & rotate neck to same side	Dorsal rami of inferior cervical nerves
Intermediate Layer: Sacrospinalis Group (Erector Spinae)				
Iliocostalis Longissimus Spinalis	Common origin: sacrum, iliac crest, and lumbar spinous process	Ribs T & C spinous process, mastoid process T-spine: spinous process	Laterally flex, extend, and rotate head (to same side) and vertebral column	Dorsal rami of spinal nerves
All have three parts: thoracis, cervicis, and capitis				

Gambar 4. Susunan Otot Tulang Belakang bagian Profundus

Schematic demarcation of dermatomes (according to Keegan and Garrett) shown as distinct segments. There is actually considerable overlap between any two adjacent dermatomes.



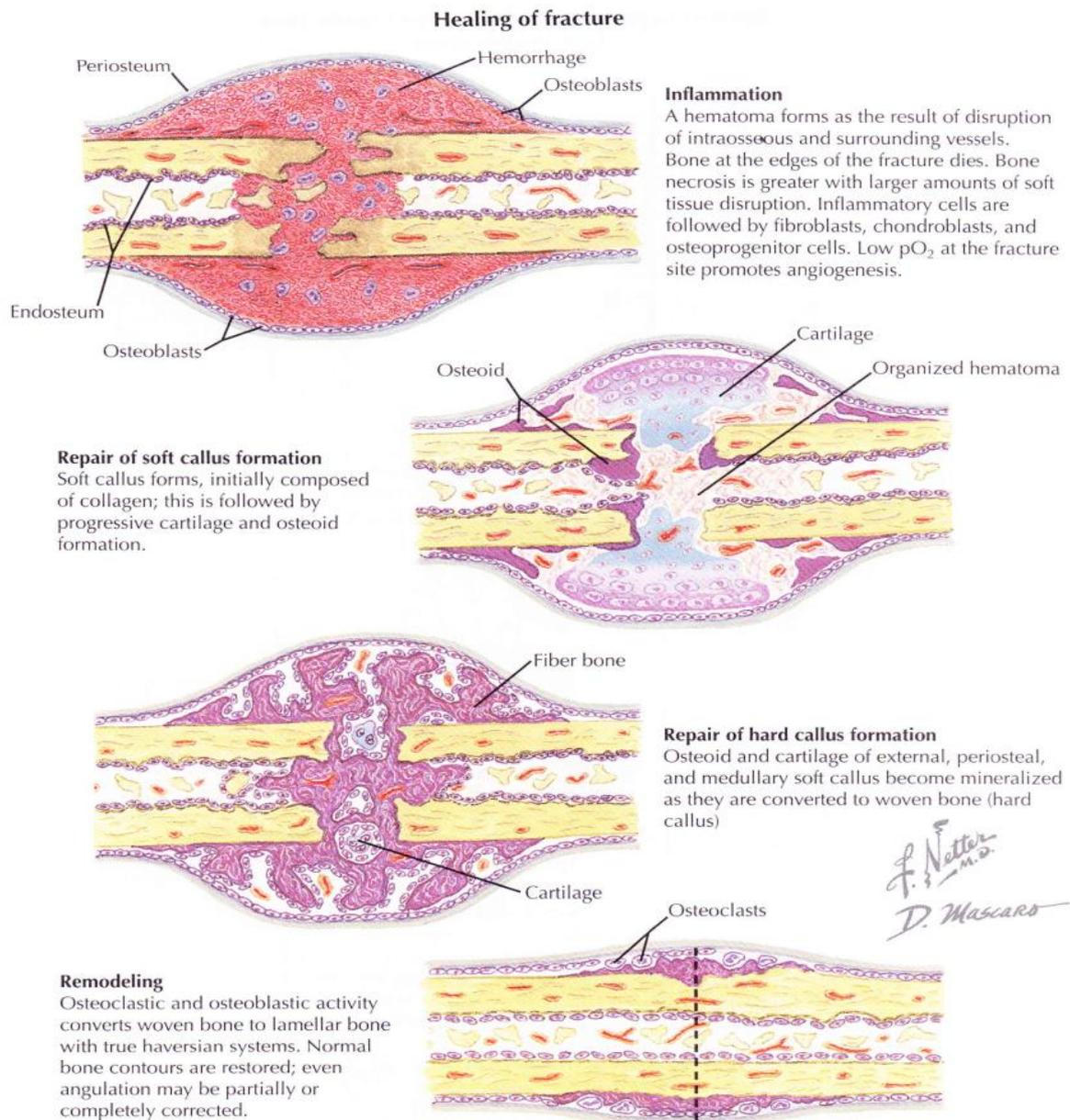
Levels of principal dermatomes

- C5 Clavicles
- C5, 6, 7 Lateral parts of upper limbs
- C8, T1 Medial sides of upper limbs
- C6 Thumb
- C6, 7, 8 Hand
- C8 Ring and little fingers
- T4 Level of nipples

- T10 Level of umbilicus
- L1 Inguinal or groin regions
- L1, 2, 3, 4 Anterior and inner surfaces of lower limbs
- L4, 5, S1 Foot
- L4 Medial side of great toe
- S1, 2, L5 Posterior and outer surfaces of lower limbs
- S1 Lateral margin of foot and little toe
- S2, 3, 4 Perineum

Gambar 5. Skema Dermatome

Fisiologi Tulang Belakang / Spine



STAGE	COMMENT
FRACTURE HEALING	
	Fracture healing occurs as a continuum with three stages: inflammation, repair (callus formation), remodeling. <ul style="list-style-type: none"> To heal, most fractures require good blood supply (most important) and stability. Callus formation does not occur after rigid fixation of fractures (ORIF); instead primary/direct healing occurs. Smoking and NSAIDs both inhibit bone/fracture healing.
Inflammation	• Hematoma develops & supplies hematopoietic/osteoprogenitor cells. Granulation tissue forms.
Repair	• Soft callus: cells produce a cartilage (soft) callus that bridges the bone ends (bridging callus) • Hard callus: replacement of soft callus into immature (woven) bone (enchondral ossification)
Remodeling	• Immature (woven) bone is replaced by mature (lamellar) bone

Gambar 6. Fase-fase dalam Penyembuhan Tulang

STRUCTURE	COMMENT
JOINTS	
Synovial (diarthrodial) joints are found at the ends of two adjacent bones that articulate.	
Articular cartilage	<ul style="list-style-type: none"> Extremely smooth (nearly frictionless) covering of the bone ends that glide on each other It can be injured leading to pain, degeneration, or dysfunction
Subchondral bone	<ul style="list-style-type: none"> Dense bone that supports and is found directly beneath the articular cartilage Appears radiodense on plain film x-rays and has low signal (black) on MR
Synovium	<ul style="list-style-type: none"> Inner membrane lines the joint capsule "Makes" (filters plasma to produce) synovial fluid Synovial folds (<i>plicae</i>) form normally but occasionally can be pathologic
Capsule	<ul style="list-style-type: none"> Outer layer, surrounds and supports the ends of two bones in proper orientation Thickenings of the capsule (capsular ligaments) maintain stability of the joint
Synovial fluid	<ul style="list-style-type: none"> Ultrafiltrate of plasma (synovium filters it) Composed of hyaluronic acid, lubricin, proteinase, and collagenases. Viscosupplementation therapy aims to replace hyaluronic acid in the joint Function: 1. Lubrication of joint. 2. Nutrition to articular cartilage (and menisci/TFCC, etc) Laboratory evaluation is important part of workup of intraarticular processes
Other	<ul style="list-style-type: none"> Joints often have additional structures within them, including ligaments (e.g., ACL, PCL), tendons (e.g., biceps, popliteus), supporting structures (e.g., meniscus, TFCC, articular discs)
CARTILAGE	
Hyaline	<ul style="list-style-type: none"> Found in articular cartilage of synovial joints and cartilage in physes Contains <i>type II</i> collagen
Fibrocartilage	<ul style="list-style-type: none"> Found in meniscus, TFCC, vertebral disc, articular disc (e.g., acromioclavicular joint) Contains <i>type I</i> collagen

Gambar 7. Struktur sendi dan tulang rawan

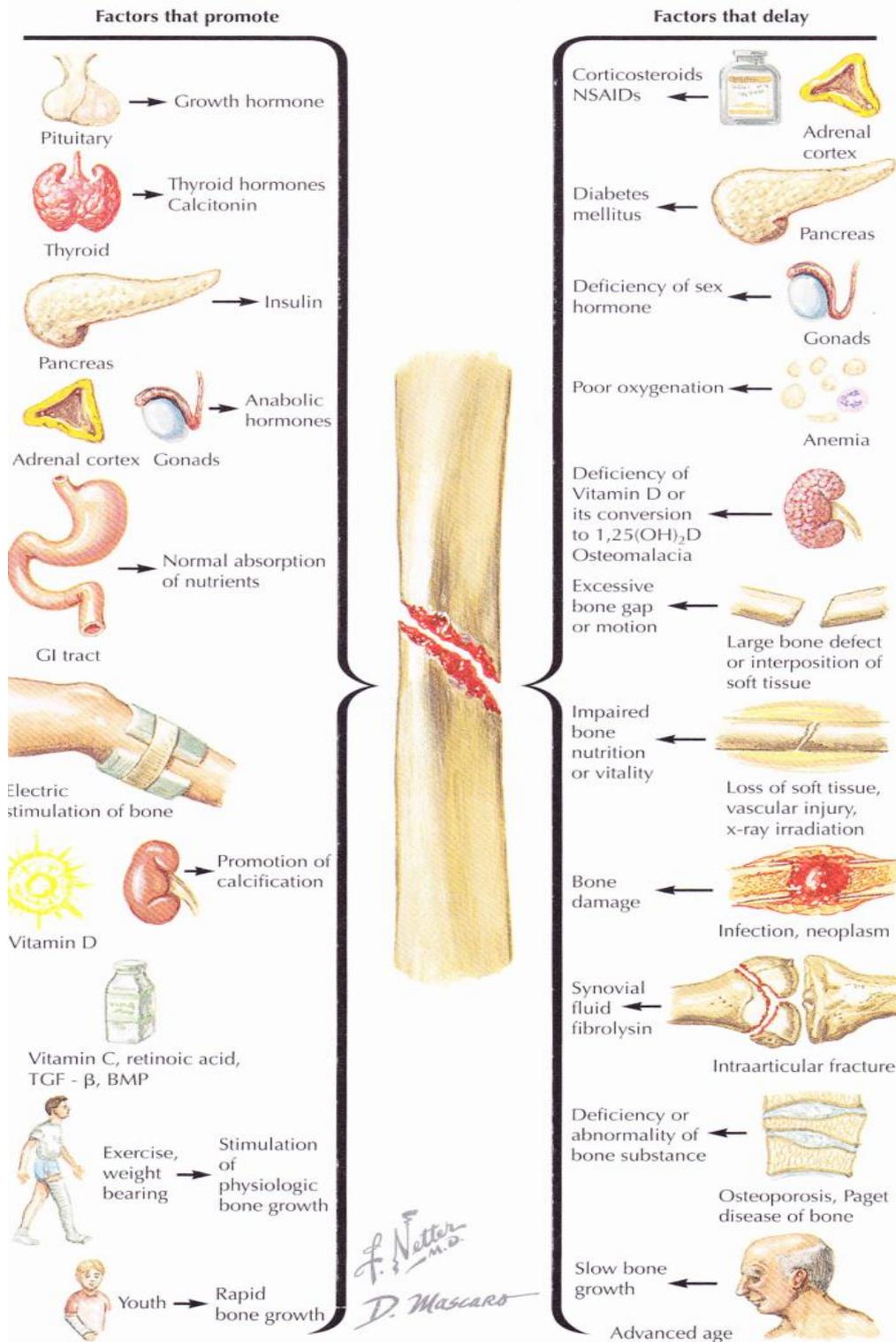
STRUCTURE	COMMENT
LIGAMENTS	
Function	<ul style="list-style-type: none"> Attach two bones to each other (usually at a joint [ACL] or b/w 2 prominences [suprascapular]) Ligaments provide stability to a joint allowing for physiologic range of motion
Types	<ul style="list-style-type: none"> Ligaments can be discrete structures (e.g., ACL or PCL) Many ligaments are thickenings of the fibrous joint capsule (e.g., ATFL in ankle)
Insertion	<ul style="list-style-type: none"> 1. Ligamentous tissue (primarily <i>type 1</i> collagen) attaches to fibrocartilage 2. Fibrocartilage attaches to calcified fibrocartilage (<i>most injuries</i> occur here) 3. Calcified fibrocartilage (Sharpey's fibers) attaches to bone/periosteum
Injury	<ul style="list-style-type: none"> Ligament injuries are termed "sprains" and are graded 1-3 <ul style="list-style-type: none"> Grade 1: stretching of ligament. Grade 2: partial tear of ligament Grade 3: complete tear of ligament Adults tend to have midsubstance injuries; children have more avulsion injuries
Treatment	<ul style="list-style-type: none"> Depending on ligament: 1. immobilization, 2. therapy, 3. surgical repair, 4. surgical reconstruction
Ligament strength	<ul style="list-style-type: none"> Pediatrics: ligament is stronger than physis, so physis usually injured. Sprains are less common. Adults: ligament is weakest portion of joint, so sprains are common. Geriatrics: ligament is stronger than weaker bone, so fracture more common than sprain.

Gambar 8. Struktur Ligamen

STRUCTURE	COMMENT
ARTICULAR CARTILAGE	
Hyaline cartilage covering of intraarticular ends of bones.	
Function	<ul style="list-style-type: none"> • Smooth (nearly frictionless) surface covering the ends of articulating bones • Allows for pain-free range of motion • Avascular (nutrition from synovial fluid), aneural, alymphatic
Composition	<ul style="list-style-type: none"> • Water: up to 80% of weight. Changes with load/compression; decr. with age, increases with OA • Collagen: 90+% is type II (also types V, VI, IX, X, XI); gives tensile strength • Proteoglycans: gives compressive strength; decreases with age and allows softening • Chondrocytes: maintains cartilage, produces collagen and proteoglycans
Zones (layers)	<ul style="list-style-type: none"> • Superficial: thin layer, fibers have tangential orientation (parallel to surface), resists shear • Middle: moderate-sized layer, fibers are randomly/obliquely oriented • Deep: thick layer, fibers are vertical (perpendicular to surface), resists compression • Tidemark: ultrathin line separating deep zone from calcified zone • Calcified zone: transitional zone that attaches cartilage to subchondral bone
Injury & healing	<ul style="list-style-type: none"> • Articular cartilage is avascular; limited healing capacity, making treatment of injuries problematic • Injuries extending deep to the tidemark may heal with fibrocartilage (not hyaline) • Microfracture surgery is based on stimulating the differentiation of mesenchymal cells within the bone into chondrocytes to produce fibrocartilage healing of articular cartilage injuries

Gambar 9. Struktur Tulang Rawan sendi

Factors That Promote or Delay Bone Healing



Gambar 10. Faktor-Faktor yang mempengaruhi penyembuhan tulang

TYPE	COMMENT
INFLAMMATORY ARTHRITIS	
Rheumatoid arthritis	<ul style="list-style-type: none"> • Autoimmune disorder targeting the joint synovium • Chronic synovitis and pannus formation lead to articular surface degeneration and eventually joint destruction • Women 3:1; Labs: +RF, HLA-DR4; monocytes mediate the disease effect • Multiple extraarticular manifestations: ocular, skin nodules, vasculitis • Characterized by warm, painful joints with progressive deformity (e.g., ulnar deviation of fingers) • Radiographic findings: 1. joint space narrowing, 2. osteopenia, 3. bone/joint erosion • Treatment: primarily medical until advanced stages necessitate surgical reconstruction
Gout	<ul style="list-style-type: none"> • Monosodium urate crystal deposition in joint/synovium • Labs: elevated serum uric acid; synovial analysis: negatively birefringent crystals • Typical presentation: monoarticular arthritis (1st MTPJ #1 site); symptoms can be self-limiting • Treatment consists of indomethacin (NSAID) & colchicine
Pseudogout	<ul style="list-style-type: none"> • Deposition of calcium pyrophosphate dihydrate crystals (CPPD) in the joint • Chondrocalcinosis (calcification of cartilage) can also occur (e.g., calcification of meniscus) • Monoarticular arthritis in older patient is typical presentation; women>men • Synovial analysis shows weakly positive birefringent crystals
Reiter's syndrome	<ul style="list-style-type: none"> • Triad: urethritis, conjunctivitis, arthritis. Labs: +HLA-B27

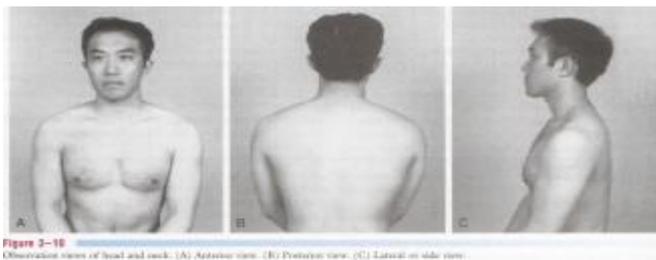
Gambar 11. Inflamasi Sendi

Panduan Tata Cara Pemeriksaan Tulang Belakang

Sebelum melakukan pemeriksaan tulang belakang, evaluasi terlebih dahulu cara berjalan (gait) dan postur. Pemeriksaan pasien dilakukan dalam empat kondisi, yaitu berdiri, berbaring dengan posisi supine, berbaring dengan posisi pronasi, berbaring dengan posisi miring.

1. Posisi Berdiri

Perhatikan cara berjalan, abnormalitas pada postur tulang belakang seperti pada gambar 1, adanya Gibbus yang merupakan bentuk kifosis yang abnormal yang melibatkan segmen tulang belakang yang pendek, sehingga membentuk sudut yang tajam berupa angulasi posterior. Evaluasi penanda neurocutaneus seperti *tuft of hair*, *lipomas*, *dimple*, *nevus*, *cafe-au-lait* yang menunjukkan adanya spina bifida. Pada kondisi skoliosis evaluasi bahu simetrical, level scapula, posisi kepala, level dari pelvis, *leg length discrepancy*. Evaluasi pergerakan pada tulang belakang mulai leher sampai pinggul.



Gambar 12. Observasi Posisi Kepala dan leher



Figure 3-11
 Example of congenital torticollis showing prominent sternocleidomastoid muscle on the right. (From Gartland, J.J.: Fundamentals of Orthopedics. Philadelphia, W.B. Saunders Co., 1987, p. 279.)

Gambar 13. Posisi Kepala dan leher yang abnormal

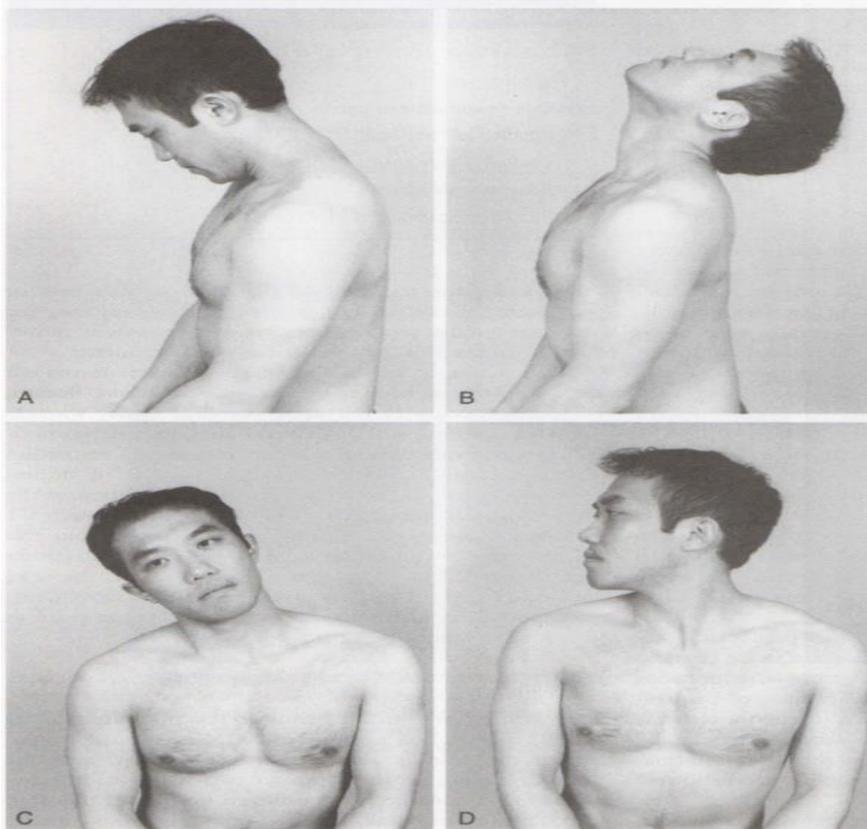
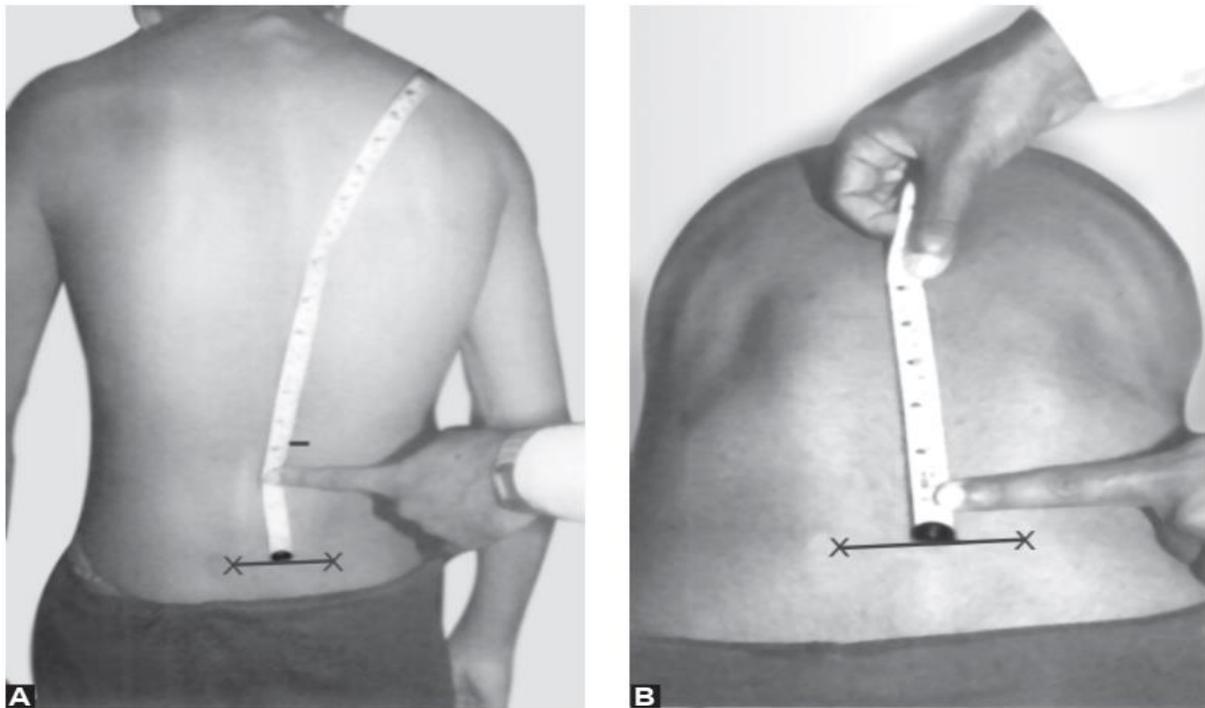


Figure 3-14
 Active movements of the cervical spine. (A) Flexion. (B) Extension. (C) Side flexion. (D) Rotation.

Gambar 14. Aktif movement pada leher



Figs 10.3A and B: Schober's test

Gambar 15. Schober's test

Tes *Schober,s* dilakukan untuk mengevaluasi fleksi pada lumbal, dengan cara identifikasi dan beri tanda pada dimple kanan dan kiri yang dihubungkan dengan garis horisontal. Beri tanda diatas garis yang menghubungkan dimple kurang lebih 10 cm, pasien diminta melakukan fleksi lumbal maksimal. Lumbal ekskursi kurang lebih 5 cm, jika kurang dari 3 cm menunjukkan adanya hambatan pada fleksi lumbal sperti pada ankylosing spondylitis.

2. Posisi berbaring supinasi

Evaluasi adanya deformitas, pembengkakan, atrofi otot. Evaluasi juga pada pelvis dan abdomen. Lakukan pemeriksaan stretch test pada dura.

Straight Leg Raising (SLR) test

Pasien diminta mengangkat tungkai secara aktif tanpa fleksi lutut, evaluasi adanya nyeri menjalar dari pinggang ke kaki, kemudian dilanjutkan dengan pasif movemen sebagai konfirmasi. Tes positif jika muncul nyeri yang menjalar pada sudut elevasi antara 30⁰ sampai 70⁰. Lakukan pemeriksaan status neurologi meliputi motorik, sensorik, dan refleks seperti pada gambar 19-20.

3. Posisi berbaring pronasi

Pada posisi ini atrofi pada otot daerah posterior akan lebih tampak. Lakukan palpasi pada prosesus spinosus untuk mengevaluasi adanya pergeseran atau penonjolan, serta nyeri tekan pada midline sampai 3 jari kearah lateral dari midline pada level sendi facet.

Lakukan tes stretch pada femoral nerve root (L2,3,4 root) dengan cara melakukan ekstensi pada pinggul dan secara pasif lutut difleksikan. Positif jika pasien merasakan nyeri pada paha bagian depan dan bertambah nyeri jika pinggul di hiperekstensi.



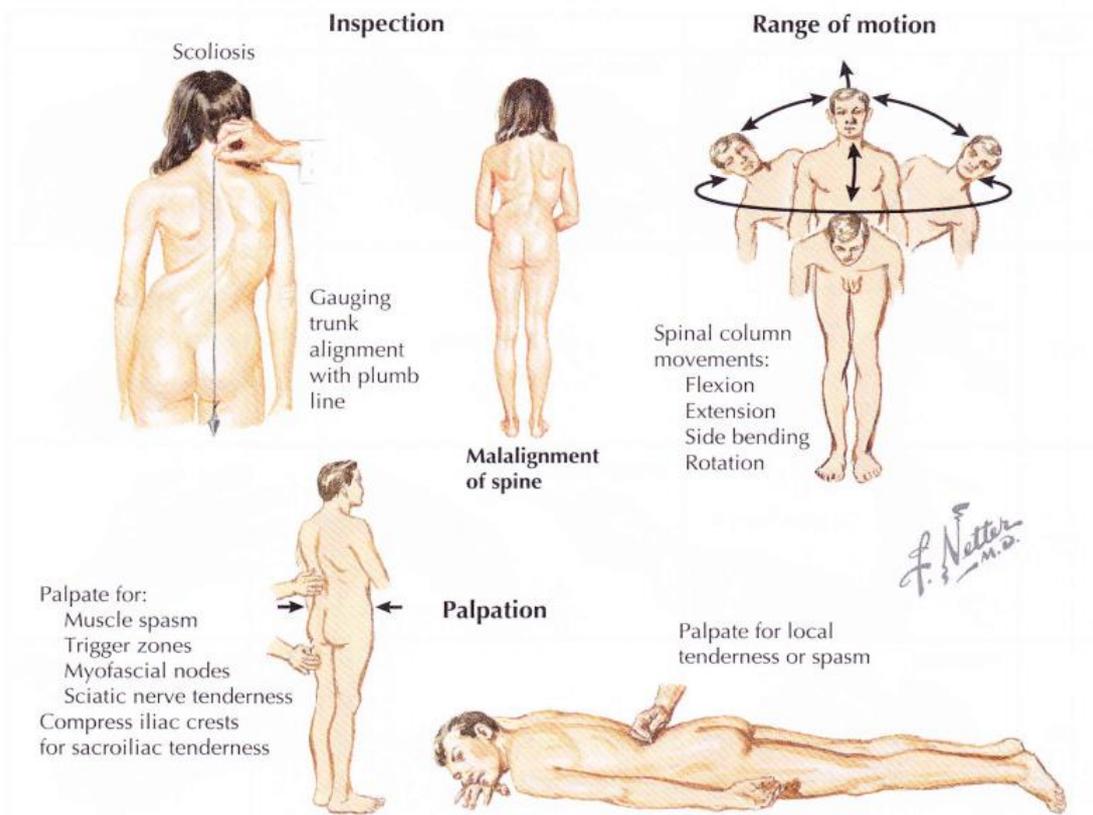
Gambar 16. Femoral Stretch test



Gambar 17. SLR test

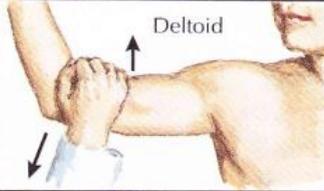
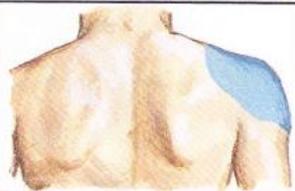
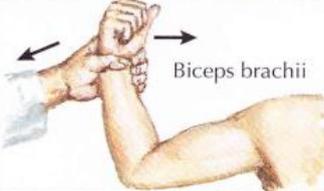
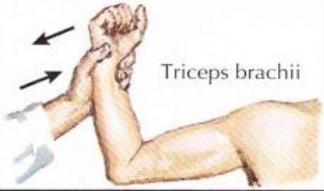
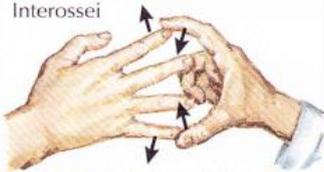
4. Posisi berbaring miring

Evaluasi sensasi pada *saddle area* (S3,4) dan refleks anal (S4,5). Pemeriksaan colok dubur harus dilakukan pada posisi ini jika ada kecurigaan cedera pada *spinal cord* atau *cauda equina syndrome*. Evaluasi sendi sacroiliaca dan kedua pinggul.



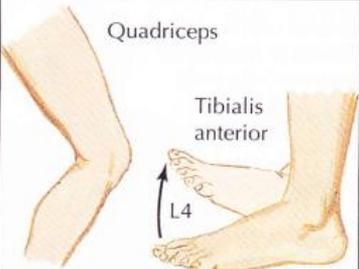
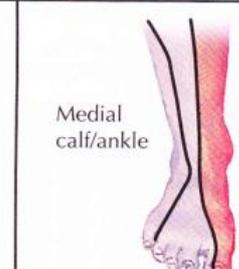
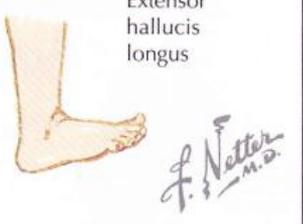
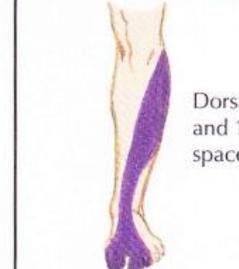
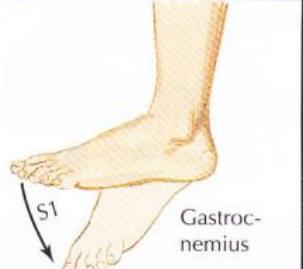
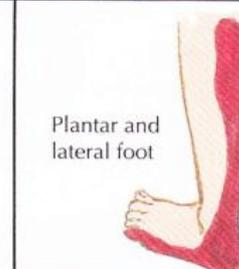
EXAM	TECHNIQUE	CLINICAL APPLICATION
INSPECTION		
Gait	Leaning forward Wide-based	Spinal stenosis Myelopathy
Alignment	Malalignment	Dislocation, scoliosis, lordosis, kyphosis
Posture	Head tilted Pelvis tilted	Dislocation, spasm, spondylosis, torticollis Loss of lordosis: spasm
Skin	Disrobe patient	Cafe-au-lait spots, growths: possibly neurofibromatosis Port wine spots, soft masses: possibly spina bifida
PALPATION		
Bony structures	Spinous processes	Focal/point tenderness: fracture; step-off: dislocation/ spondylolisthesis
Soft tissues	Cervical facet joints Coccyx, via rectal exam Paraspinal muscles	Tenderness: osteoarthritis, dislocation Tenderness: fracture or contusion Diffuse tenderness: sprain/muscle strain; trigger point: spasm
RANGE OF MOTION		
Flexion/extension: cervical Flexion/extension: lumbar	Chin to chest/occiput back Touch toes with legs straight	Normal: Flexion: chin within 3-4cm of chest; ext. 70° Normal: 45-60° in flexion, 20-30° in extension
Lateral flexion: cervical Lateral flexion: lumbar	Ear to shoulder Bend to each side	Normal: 30-40° in each direction Normal: 10-20° in each direction
Rotation: cervical Rotation: lumbar	Stabilize shoulders: rotate Stabilize hip: rotate	Normal: 75° in each direction Normal: 5-15° in each direction

Gambar 18. Pemeriksaan pada posisi berdiri

Level	Motor	Reflex	Sensory
C5	 Deltoid	 Biceps brachii	
C6	 Biceps brachii	 Brachioradialis	
C7	 Triceps brachii	 Triceps brachii	
C8	 Interossei	 None	

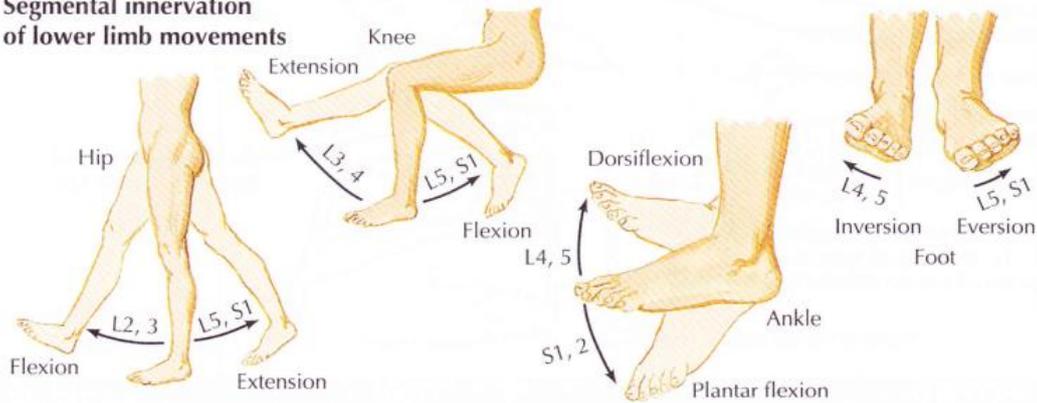
EXAM	TECHNIQUE	CLINICAL APPLICATION
NEUROVASCULAR		
Cervical		
Sensory		
C5	Lateral shoulder	Deficit indicates a corresponding cervical root compression/lesion
C6	Thumb	Deficit indicates a corresponding cervical root compression/lesion
C7	Middle finger	Deficit indicates a corresponding cervical root compression/lesion
C8	Ring & small fingers	Deficit indicates a corresponding cervical root compression/lesion
T1	Ulnar forearm & hand	Deficit indicates a corresponding cervical root compression/lesion
Motor		
C5	Deltoid: resisted abduction	Weakness indicates corresponding cervical root compression/lesion
C6	Biceps: resisted elbow flexion	Weakness indicates corresponding cervical root compression/lesion
C7	Triceps: resisted elbow ext.	Weakness indicates corresponding cervical root compression/lesion
C8	Intrinsics: resisted finger abduction	Weakness indicates corresponding cervical root compression/lesion
T1		Weakness indicates corresponding cervical root compression/lesion
Reflexes		
C5	Biceps	Hypoactive/absent indicates C5 radiculopathy
C6	Brachioradialis (BR)	Hypoactive/absent indicates C6 radiculopathy
C7	Triceps	Hypoactive/absent indicates C7 radiculopathy
Inverted radial	Tap BR tendon in distal forearm	Hypoactive brachioradialis & hyperactive finger flexion: myelopathy
Hoffman's	Flick MF DIPJ into flexion	Pathologic if thumb IPJ flexes: myelopathy
Pulses		
	Brachial, radial, ulnar	Diminished/absent = vascular injury or compromise

Gambar 19. Pemeriksaan Status Neurologis Anggota gerak atas

Level	Motor	Reflex	Sensory
L4	 <p>Quadriceps Tibialis anterior L4</p>	 <p>Patella tendon ("knee jerk")</p>	 <p>Medial calf/ankle</p>
L5	 <p>Extensor hallucis longus F. Netter M.D.</p>	None	 <p>Dorsal foot and 1st web space</p>
S1	 <p>Gastrocnemius S1</p>	 <p>Achilles tendon ("ankle jerk")</p>	 <p>Plantar and lateral foot</p>

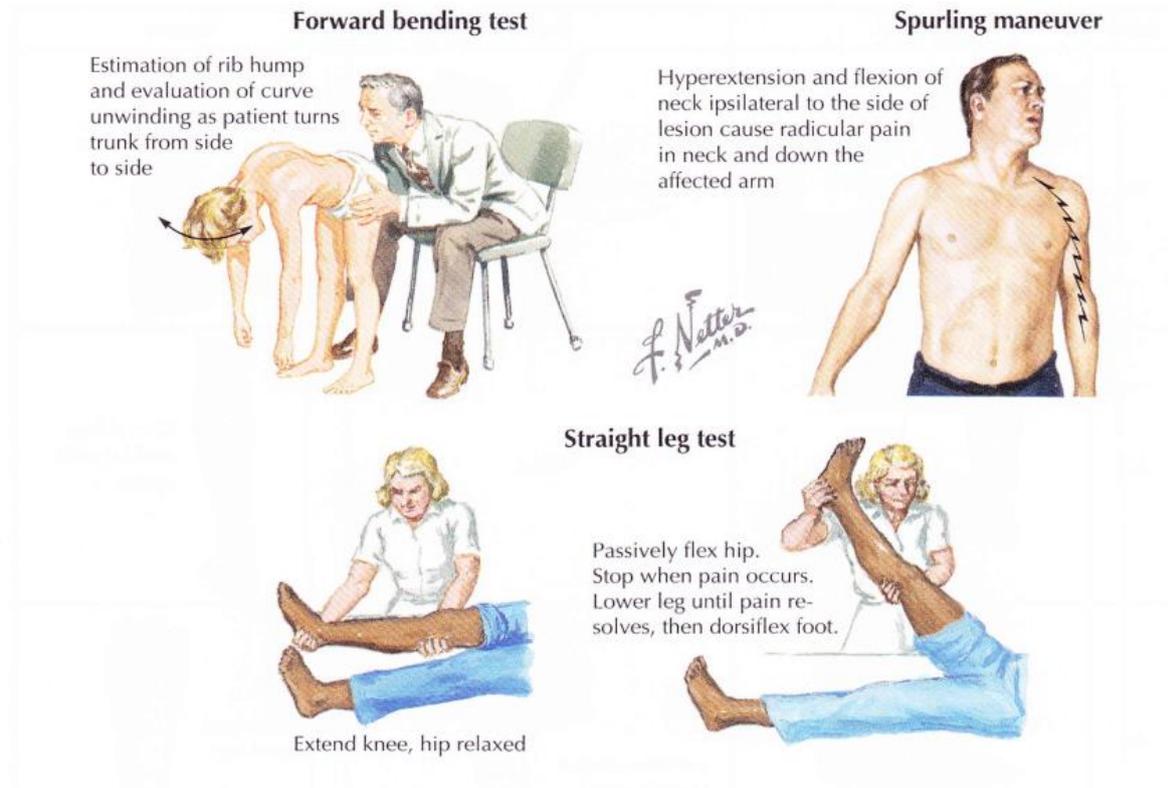
EXAM	TECHNIQUE	CLINICAL APPLICATION
NEUROVASCULAR		
Lumbar		
Sensory		
L3	Anterior & medial thigh	Deficit indicates corresponding lumbar root compression/lesion
L4	Medial leg & ankle	Deficit indicates corresponding lumbar root compression/lesion
L5	Dorsal foot & 1st web space	Deficit indicates corresponding lumbar root compression/lesion
S1	Lateral & plantar foot	Deficit indicates corresponding lumbar root compression/lesion
S2-4	Perianal sensation	Deficit indicates corresponding lumbar root compression/lesion
Motor		
L3-4	Quadriceps: knee extension	Weakness indicates corresponding lumbar root compression/lesion
L4	Tibialis anterior: ankle DF	Weakness indicates corresponding lumbar root compression/lesion
L5	Extensor hallucis longus: toe DF	Weakness indicates corresponding lumbar root compression/lesion
S1	Gastrocnemius: ankle PF	Weakness indicates corresponding lumbar root compression/lesion
S2-4	Anal sphincter: anal squeeze	Weakness indicates corresponding lumbar root compression/lesion
Reflexes		
L4	Patellar tendon ("knee jerk")	Hypoactive/absent indicates L4 radiculopathy
S1	Achilles tendon ("ankle jerk")	Hypoactive/absent indicates S1 radiculopathy
S2-3	Bulbocavernosus	Hypoactive/absent indicates S2-3 radiculopathy or spinal shock
Babinski	Run stick along plantar foot	Upgoing great toe: upper motor neuron/myelopathy
Ankle clonus	Rapidly flex & extend ankle	Multiple beats of clonus: upper motor neuron/myelopathy
Pulses		
	Posterior tibial, dorsalis pedis	Diminished/absent = vascular injury or compromise

Segmental innervation of lower limb movements



LEVEL	MOTOR	SENSORY	REFLEX	COMMENT
LUMBOSACRAL ROOTS				
L1	Transversus abdominis Internal oblique	Inguinal region	None	Rarely injured nerve root
L2	Psoas	Upper thigh	None	Test with hip flexion
L3	Quadriceps	Anterior and medial thigh	None	L3 & L4 tested with quadriceps
L4	Tibialis anterior	Medial leg, ankle, foot	Patellar	Test with ankle dorsiflexion
L5	Extensor halluc longus	Dorsal/plantar foot, 1st web space, lateral leg	Hamstring	Most commonly compressed lumbar root; test with hallux dorsiflexion
S1	Gastrocnemius	Lateral foot, posterior leg	Achilles	Test with ankle plantar flexion/toe walking
S2-4	Sphincter	Perianal sensation	Anal wink	Test tone to evaluate for cauda equina syndrome

Gambar 20. Pemeriksaan Status Neurologis Anggota Bawah



EXAM	TECHNIQUE	CLINICAL APPLICATION
SPECIAL TESTS		
Cervical		
Spurling	Axial load, then laterally flex & rotate neck	Radiating pain indicates nerve root compression
Distraction	Upward distracting force	Relief of symptoms indicates foraminal compression of nerve root
Kernig	Supine: flex neck	Pain in or radiating to legs indicates meningeal irritation/infection
Brudzinski	Supine: flex neck, hip flex	Pain reduction with knee flexion indicates meningeal irritation
Lumbar		
Straight leg	Flex hip to pain, dorsiflex foot	Symptoms reproduced (pain radiating below knee) indicative of radiculopathy
Straight leg 90/90	Supine: flex hip & knee 90°, extend knee	>20° of flexion = tight hamstrings: source of pain
Bowstring	Raise leg, flex knee, popliteal press	Radicular pain with popliteal pressure indicates sciatic nerve cause
Sitting root (flip sign)	Seated: distract patient, passively extend knee	Patient with sciatic pain will arch/flip backward when knee extended
Forward bending	Standing, bend at waist	Asymmetry of back (scapula/ribs) is indicative of scoliosis
Hoover	Supine: hands under heels, patient then raises one leg	Pressure should be felt under opposite heel. No pressure indicates lack of effort, not true weakness
Waddell signs	Presence indicates nonorganic pathology: 1. Exaggerated response/overreaction, 2. Pain to light touch, 3. Nonanatomic pain localization, 4. Negative flip sign with positive straight leg test	

Gambar 21. Special test

Hal-hal yang harus diperhatikan pada pemeriksaan tulang belakang adalah:

1. Universal Precaution (penggunaan APD)
2. Perkenalan diri dan menjelaskan setiap pemeriksaan yang akan dilakukan dan tujuannya
3. Jangan menambah cedera pada pasien (First Do No Harm)

Alat-alat yang dibutuhkan

1. Goniometer
2. Manekin atau Probanus
3. Meteran
4. LCD Projector
5. White Board
6. Reflex Hammer
7. Tempat tidur periksa

Checklist :

PEMERIKSAAN TULANG BELAKANG (SPINE)

NO	ASPEK YANG DILAKUKAN	BOBOT	NILAI		
			0	1	2
1	Salam dan memperkenalkan diri ke pasien				
2	Meminta ijin akan memeriksa pasien				
3	Tulang belakang (spine)				
	a. Look				
	b. Feel				
	c. Move of cervical · Fleksi & ekstensi · <i>Lateral fleksi</i> · <i>Rotation</i>				
	d. Move of thoracolumbal · <i>Forward flexion</i> · <i>Extention</i> · <i>Lateral fleksi</i> · <i>Rotation</i>				
	JUMLAH (A)				

Ket: nilai 0 : tidak dilakukan, nilai 1: dilakukan tidak sempurna, nilai 2: sempurna

NO	PENILAIAN PERFORMANCE	NILAI			
		1	2	3	4
1	Komunikasi				
2	Sikap professional				
3	Performance selama pemeriksaan				
4	Kualitas teknik pemeriksaan				

DAFTAR PUSTAKA

Netter's Concise Orthopaedic Anatomy, 2nd Edition, 2010, Saunders Elsevier, Philadelphia

C Rex; S Rajasekaran; Charles SB Galasko, Clinical Assesment and Examination in Orthopedics, 2nd Ed., Jaypee Brothers Medical Publishers, New Delhi; Panama; London, 2012

David J. Magee, Orthopedic Physical Assesment, 4th Ed., Saunders Elsevier, St. Louis, 2006