

ArgoSpine 2009

SpineSurgery and
Advances in Medical
Imaging

* The repetition being the base of teaching, we will oblige you to hear again all that was exposed during these two days!

* But you reassure, that will be strongly summarized!

J. DUBOUSSET

Evolution of imaging capacities in the management of scoliosis

- * History : Plaster braces a good method to understand scolioses
- * CT Scan reconstruction, 3D views
- * Stereo views with ENSAM
- * **1995 : EOS machine from Charpak Invention : complete view of the scoliosis, XRay dosis reduction**
- * Mathematical formula of scoliosis will be able to calculate scoliosis in the future
- * View from the top : the true view of scoliosis
- * Check the effect of brace onthe chest
- * **Coupling EOS and 3D reconstruction enables simulation of therapeutic solution and predict the result of surgery**
- * Chapter of the soft tissues

J. DUBOUSSET

Evolution of imaging capacities in the management of scoliosis

- * Chapter of the soft tissues
- * Myelogramm
- * MRI, dynamic MRI
- * CTScan and MRI are very complementary
- * Angiography Djindjian 1963, now selective angiography of the Adamkiewicz artery
- * Ultrasonography for neonatal
- * **Future : muscles quantified analysis**
- * **Brain and Spine Tractography**

Denis DUCROUX
**Evolution of imaging capacities in the
management of scoliosis**

- * Tractography Diffusion Tensor MRI and Fibertracking
- * Water diffusion isotropic and anisotropic diffusion in the extracellular spaces
- * Possible with MRI but needs to know algorithms and help of physicist and mathematics
- * 3D Reconstruction of the water along the traks
- * **Enables the view of the nervous fibres and the nerve roots**
- * **In case of metastatic compression of the spinal cord, the location of the maximal compression became visible, prognosis is so possible**

TUMORS

Surgeons point of view

- * Gasparriani : 1035 cases of Tumors of the Spine
- * Diagnosis, Staging oncological, surgical, Planning of surgery
- * Oncological staging : intra- and extra-compartmental development
 - * Clinical findings
 - * Xray
 - * CT-scan
 - * MRI
 - * Isotope/Pet scan
 - * CT-Guided biopsy

TUMORS

Surgeons point of view

Oncological staging

- * Surgical staging
 - * **Where is the capsule**
 - * **Definition of surgical margins**
 - * Intra-lesional Excisions
 - * **Angiography necessary for embolization before surgery, allows removal without bleeding**
 - * Resection of Dura in some cases
 - * Resection of Adamkiewicz artery in some cases : possibility of development of a new ADK artery !
 - * **ONE SHOT SURGERY : THE FIRST STEP DETERMINATE THE PROGNOSIS**

Pre-operative assessment N. Kawahara

- * preoperative embolization
- * Triple level embolisation : diminution of blood loss and operative time
- * Embolisation : necrosis, oedema and the risk of cord compression
- * How many embolisation level without AK artery (dog <5 pairs)
- * Including AK artery (dog <4 pairs ligation)
- * Maximum 3 pairs including AK artery sacrificed without problems

TUMORS

Surgeons point of view

- * Simonetti MRI gadolinium enhancement and traditional angiography vs **angio-MRI**
 - * Traditional angiography is to be asked first WHY ?
 - * Today MR Angiography is' nt able to assess the vascularization of the tumour
 - * **Is the first step to perform selective embolization**

Assessment of post operative mechanical evolution...
P.J. Papagelopoulos

- * Local and general status
- * Each 3 or 4 months
- * Local recurrence, systemic assessment

Assessment of post-operative mechanical evolution

* Robert MELCHER

- * Follow-up evaluation before discharge surgery
- * Based on then growing of the tumor
- * Control for local recurrence
- * Control of construct stability
- * Control for metastasis
- * Timing of chek up depends of the category of the tumor

Assessment of post operative mechanical evolution...

Radiologist point of view

T. Welk

- * Good preoperative evaluation: MRI CT
- * Artefact of the instrumentation
- * Ct myelography in to avoid artefact? long instrumentation
- * MRI for tumor recurrence, tumor rests (same sequence same orientation)
- * Between 2 op sequences
- * Intra op in difficult cases to localize the lesion
- * Post op if possible: if restreop, 6 weeks better to see tumors
- * Ct: calcified structures, recalcification of osteolyses
- * MRI bone marrow infiltration

The radiologist as a coculprit in the Failed back Surgery Syndrome

R. Jenkins

- * Medical imaging of source of error
- * Diagnostic error : missed, wrong diagnosis, underdiagnosis (severity, adjacent level, multiplicity...)
- * The radiologist cannot diagnose what they cannot see
- * The clinician cannot treat what they cannot see

Diagnosis of spine tumour and Infection by imaging K. Tomita

- * Collapsed spine : **metastatic, infectious**, rheumatology, osteoporosis...
- * The progression make the difference
- * Spondylitis : The disc end plate : is rough, start near the end plate, the margin is osteosclerotic, extend to the adjacent vertebra
- * Metastatic : early detection? pedicle sign (one eyed vertebra), disc height is normal, end plate is smooth, start in the body, margin is osteolytic, do not extend to the adjacent vertebra
- * The explanation : the bacteria are small and going far away in the small vessel near of the end plate (metaphysis)
- * **Infection : Curettage**
- * **Tumour : Resection en bloc, and medical treatment : team treatment**

Emergency ward, polytrauma management R.Emery

- * Spinal fracture may be masked : Head injuries...
- * Risk factors : age 65, mechanism...
- * Whiplash, associated fracture,
- * X ray Lateral, open mouth, dynamic after days
- * CT : polytrauma, unconscious, but not for ligamentous injury
- * MRI : soft tissues (ligamentous, neuro) injuries
- * Unconscious : CT and MRI
- * Finally : commonsense

Emergency ward, polytrauma management
Radiologist point of view
J.C.Dosch

- * patient stable : total body CT , MRI, No X rays
- * Instable : X rays CS Lat, Chest AP, Pelvis AP, sonography
- * What Tools : haversianbone fracture CT
- * Trabecular fractures : MRI
- * **Normal CT safe enough to exclude a lesion? Yes**
- * Spinal cord injuries MRI, nerve injury not urgent, vascular injury angio CT

Emergency ward, polytrauma management

- * JC. Dosch : Radiologists point of view
 - * What tools ?
 - * Multi Directional CT > CT > MRI in haversen bone fracture
 - * MRI > MDCT for vertebral body
 - * **Is Helicoidal CT Scan sufficient for soft tissue ?**
 - * **Yes because of indirect signs**
 - * Different kind of lesions and examples
 - * **Multi Directional CT is save enough**
 - * **Additional MRI can be necessary**

Upper cervical spine injuries

- * JC. Dosch : Radiologists point of view
 - * MSCT usefull
 - * Radiological landmarks in lateral view, open mouth
 - * Ligamentous structures mRI lateral view and axial view
 - * Different lesions
 - C1-C2 dislocation only visible in flexion
 - Rotatory fixation
 - different classifications

C1/C2 instability is translation of a ligamentous lesion

Upper cervical spine injuries

- * C. Villas Surgeons point of view
 - * Ligaments do not heal well
 - * 10 % late diagnosed
 - * Not only traumatic, also rheumatoid diseases
 - * Vertical instability always unstable, often death, some survival cases
 - * Antero-posterior instability to be fixed
 - * Rotatory instability FIXED

Degenerative cervical spine, disease and cervical discopathy

- * B. Ashman

- * Causes of walking disorders : spondylotic, syringomyelia, Sp. Cord tumor, ischaemia etc

- * CervSpine Myelopathy (CSM)

- * Compression causes

- * Clinical signs : change in walking – unsteadiness, spasticity lower limbs, upper limb weakness, hyperreflexia ...

- * Scales : JOA and Nurric

- * X-Ray features loss of lordosis, osteophytes, facet arthrosis

Degenerative cervical spine, disease and cervical discopathy

* T. Welk

* Preoperative Assessment

- * Functional Myelography
- * CT Scan : better for bony lesions
- * CT Scan post-myelography ++++ good for exact localisation of compressions
- * Plane X-Ray after myelography : more chance to see the compressed nerve root

* In case of short neck

- * CT better to see the lower spine
- * Myelography is invasive MRI should be done before myelography

Assessment of vertebral artery injury in trauma
Surgeons point of view
R. Melcher

- * 70 % vertebral artery injuries have a cervical spine fracture
- * 40% transverse process fracture, subluxation, upper cervical localisation
- * Asymptomatic
- * Embolism, occlusion : neurological outcome
- * Anticoagulation
- * Follow up is important

Assessment of vertebral artery injury in trauma
Surgeons point of view
P. Kehr

- * Experience in secondary surgery
- * The narrowing of the artery come from outside in opposition with osteoarthrodesis
- * Seldom indications today
- * But important to know

Degenerative cervical spine Assessment of arm pain
D.Kaech

- * C5 Shoulder, C6 Hitchhiker, C7 victory, C8 Finger
- * MRI ,exception CT, RX dynamic for instability, or functional MRI
- * Quick main compression ant or post : approach
- * Foraminotomy (post) singer (reccurent, carotidstenosis...)
- * Discectomy, corporectomie (ant)

Assessment of walking disorders B. Ashman

- * Cervical myelopathy, intracranial causes
- * Change in walking, weakness (spasticity, hyperreflexia)
- * Xray : narrowing, instability, better CT scan, MRI
- * Electrophysiology SEP

MRI, CT, Myelography T. Welk

- * Multilevel : Which level is important
- * Myelography : Functional images
- * CT : for calcification
- * MRI versus Myelography:
- * Advantages : nerves compression, with implants
- * Inconvenients : Lower cervical spine, complete compression
- * More invasive, additional information to the standard MRI, MRI before the myelography

Degenerative cervical spine, disease and cervical discopathy

- * JP Elsig : Functional MRI
 - * Exemple of transientquadriparesiswithdrop-attack
 - * F-MRI permits to see a Disc Hernia C5-C6 and a Chiari malformation in C0-C1 >surgeryinsteadpsychotherapy !
 - * Other exemples demonstrate the high value of F-MRI in order to treatadequatly the patients

Interventional Radiology state of the art A. Gangi

- * Image are better and better
- * **Trauma** : Kyphoplasty in young patients, good selection T11T12 magerl A 1
- * A3 kyphoplasty and surgery to avoid the anterior approach
- * Performed within 7 days
- * **Percutaneous tumor management** :
 - * palliative tmt, osteolytic lesions cementoplasty for pain management, for debulging the tumor
 - * Laser ablation : osteoid osteoma risk for the neural tract and the arteries monitoring of the temperature
 - * Cryoablation freeze to destroy the smallest lesions < 3cm
 - * Osteoblastoma toxic effect after oedema
 - * Hemangioma : with extension embolisation, sclerotherapy preoperative without bleeding
 - * Volumic reconstruction is important

Lumbar disc replacement : Surgeon Point of view

* J. Delecrin

* Comparison of Mobile-coreprosthesis and fixed-core

- * Mobile-coremimicsphysiologic motion
- * Fixed-coreis not physiologic
- * Lowcore-translation and highvertebral translation in L4-L5 and opposite in L5-S1
- * M-coreavoidsexcess of vertebral translation
- * At L4L5 restores physiologicalintervertebralmobility
- * At L5S1 fails to restore physiologicalintervertebralmobility

Lumbar disc replacement : Surgeon Point of view

- * JP Steib
- * Blood vessels
 - * Veina division in front of the disc L4-L5 in majority of cases
 - * L4-L5 surgery : ilio-cavephlebogram
- * Bonedensity
 - * Important to know for avoiding subsidence

Lumbar disc replacement : Surgeon Point of view

- * JP Steib
- * Revisionsurgery
 - * Second spinesurgery : againvessels, necessity of a vascular surgeon
- * Appreciation of anatomy is crucial for a disc arthroplasty

Lumbar TDR assessment of vascular anatomy, bone density in preop planning

J.P.Steib

- * Vessels (veins) the main obstacle
- * Large exposure (more than for fusion)
- * Phlebogram better than angiogram
- * Bone density : age, X ray Bone density
- * Second surgery : peritoneal adhesion, ureter again the vessels

Lumbar TDR assessment of vascular anatomy, bone density in
preop planning
L. Simonetti

- * Adamkiewicz Artery
- * MR angiography, CTA : in 90% , alternative to arteriography
- * 17% double AKA
- * Embolisation of the AKA : dangerous
- * Risk : Section of many artery or mobilisation of the cord is dangerous
- * Risk : **Section of one artery is overestimated**

Degenerative lumbar spine : Pre-operative assessment

- * K. Hasegawa
 - * Clinical data and then
 - * MRI
 - * DISCOGRAPHY
 - * CT SCAN
 - * EXAMINE ALL THE SPINE (sciatica + dysesthesia upper limb < DH C6C7)
 - * Combination with artery problem

Degenerative lumbar spine : Pre-operative assessment

- * R. Emery : Leg pain diagnosis
 - * sciatalgia : Disc herniation (90 % disappear in 6/52 !), narrowing, instability (SPL)
 - * CT guided infiltration 30 % results only
 - * Red flags : infection – psoas problem – pelvic tumor
 - * Compartment syndrom, vascular omponent, referred knee pain, sarcoma
 - * Conclusion : find what you are looking for ; do not treat an image !

Degenerative lumbar spine preoperative assessment Lumbar pain D. Kaech

- * CT and dynamic myelogram (when MRI contra indicated)
- * Mechanically induced : instability ?
- * Diagnostic infiltration?
- * Spinal balance often neglected
- * Upright MRI + EOS system in the future?

Degenerative lumbar spine preoperative assessment Imbalance J. P. Steib

- * Loss of hip extension (sitting position) and the loss of lordosis (bearing weight)
- * Walking pain
- * Dynamic view : myelogram, dynamic MRI
- * Opening, stabilisation, Prevent flatback
- * Never too much lordosis

Degenerative lumbar spine preoperative assessment
Walking limitation Y. Shimada

- * Change of neurologic claudication between pré and post op.
- * Treadmill examination :walk distance, time to first symptom
- * Change 1 month after surgery no difference between 2km/h and preferred speed

Validity and relevance of discography A. gangi

- * Discogram painful
- * Perfect technique to give useful information : don't touch the nerve root
- * Indicated for patient therapeutic resistant
- * Pain provocation, the resistance to the injection
- * Complication : can be important

Validity and relevance of Myelography A. Gangi

- * Invasive examination
- * Dynamic examination, poor MRI study
- * Contra indicated : claustrophobie, hardware...
- * CT with myelography to avoid miss lesions
- * Complication headache

Validity and relevance of Functional MRI J.P. Elsig

- * Sitting position the best, standing, tredelenburg
- * Position dependent low back and leg pain.

Decisionmaking in tumourresection A. Gasbarini

Degenerative lumbar spine postoperative assessment
Recurrent leg pain K. Hasegawa

Degenerative lumbar spine postoperative assessment
Recurrent lumbar pain B. Ashman

Degenerative lumbar spine postoperative assessment Recurrent lumbar pain R. Emery

- * Problem : exclusion of non fusion
- * Timing :
 - * acute : epidural haematoma, CSF leak, screw misplacement,
 - * early onset : Infection, cage migration, donor site pain, osteolysis with BMP
 - * late onset : cage subsidence, insufficiency fracture, non fusion device fracture, hyperostosis with BMP, adjacent level problems articular cysts, instability, flat back, fusion disease, epidural scar

Degenerative lumbar spine postoperative assessment Possible non-union B. Ashman

- * The three W's
- * Did we operate on the wrong patient?
- * Did we make the wrong diagnosis?
- * Did we perform the wrong operation?
- * To avoid : diagnostic and treat early, avoid 3W,
right operation

Degenerative lumbar spine postoperative assessment
Possible non-union Y. Shimada

- * Plif with local bone graft
- * Union : no motion, bone bridging 94%
- * Non union : implant failure, no bone bridging

Degenerative lumbar spine postoperative assessment Gadolinium enhancement R. Jenkins

- * Contrast enhancement
- * The problem one of diagnostic error
- * missed diagnosis : postoperative sterile radiculitis
- * Misdiagnosis : surgical sponge
- * Underdiagnosis :
- * A postoperative imaging conduct to a right treatment

Degenerative lumbar spine postoperative assessment
3 D reconstruction for assessment of fusion or non fusion J. C. Dosch

- * X rays : lateral bending views, overestimate the fusion
- * MD CT : 2D 3D solid and semi solid :
trabeculated bone transverse and facet fusion
(96%)
- * Vertebral slip
- * MRI new gold star?