FOOT DEFORMITY & PAIN BY DISEASES OF CENTRAL NERVE SYSTEM

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Foot deformity and pain

- Stroke/Traumatic brain injury
- Spinal cord injury / multiple sclerosis
- Parkinson's ds

  MSA(Multiple system atrophy)

  PSP(Progressive supranuclear palsy)

Stroke & brain injury

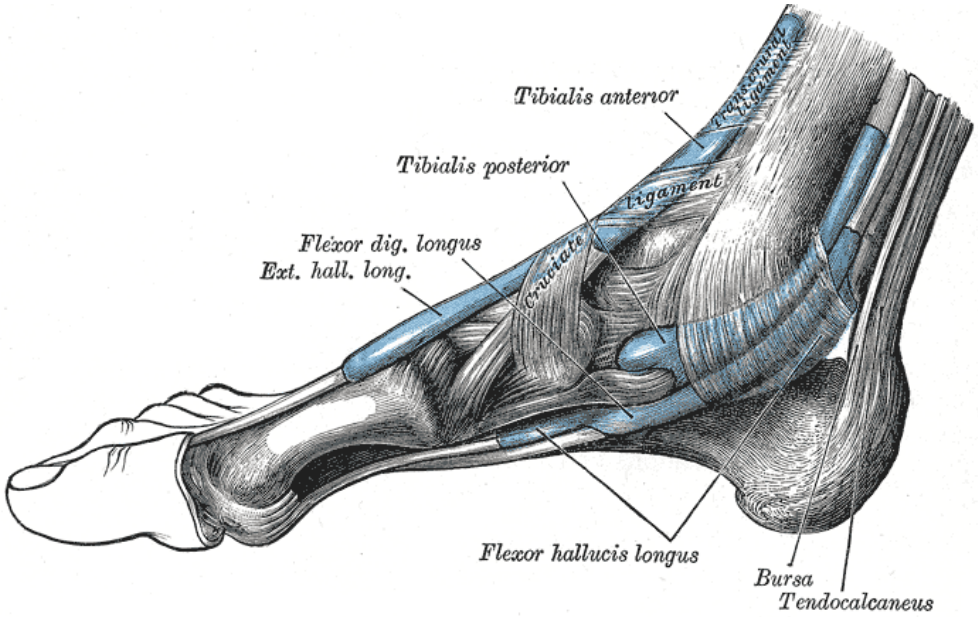
Foot deformity in stroke & Brain injury

- Spastic equinovarus
  - Equinus
  - Varus
  - Claw toes

- Cavovarus foot

Equinovarus

- Definition
  - " a combination of a plantar-fixed, an inward angulation of the rearfoot and/ forefoot(in the frontal plane)"
- Incidence in stroke
  - 10-20 %
- Muscular imbalance
  - Muscle over-activity of the calf m (triceps surae, TP, FHL, FDL, FDB)
  - Weakness of the antagonists (TA, PL, PB)
  - Muscle contracture

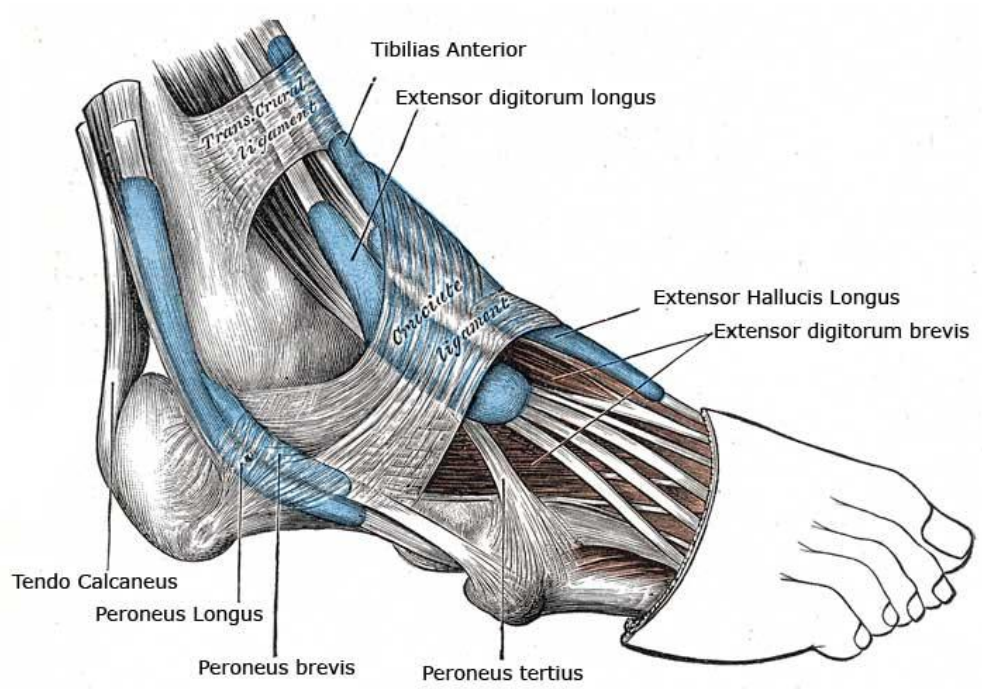


<invertor>

- TA
- TP
- EHL

<Evertor>

- PL
- PB
- EDL



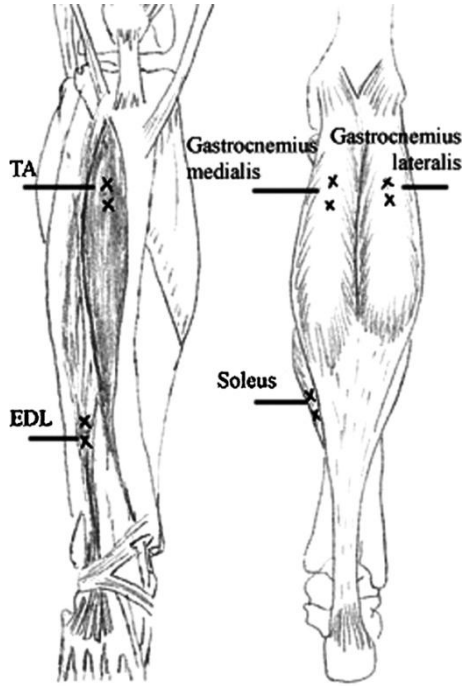
Equinovarus

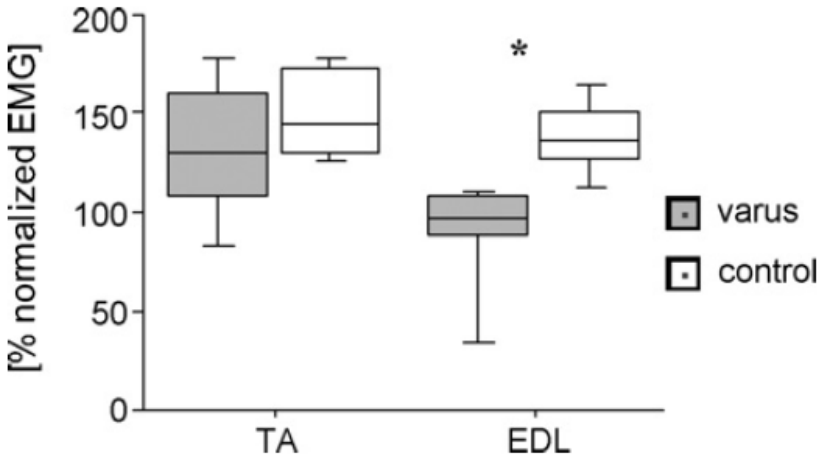
- Impaired walking capacity
  - Stance phase
    - Ankle instability
  - Swing phase
    - Foot clearance
    - Appropriate prepositioning at terminal swing
- Increased risk of falling

Foot varus in stroke patients: Muscular activity of extensor digitorum longus during the swing phase of gait

F. Reynard [a,*], O. Dériaz [a], J. Bergeau [b]

- To assess whether a muscle imbalance between TA and EDL was associated with a varus deformity of the foot during swing phase of gait in stroke





<The Foot, 2009>

- Results
  - 13 of 20 hemiplegia (65%) : foot dysfunction during swing phase
  - Calf muscle : 60% varus group / 13% control
  - Swing phase

  : EDL muscle duration ↓, amplitude ↓

  : TA muscle activity – slightly decreased
- Varus deformity
  - An inadequate activity of the calf m and TA-EDL imbalance
  - Imbalance d/t modification in EDL activity but not TA
- EDL should be selectively and intensively activated and strengthened

<The Foot, 2009>

Treatment

- Orthotics
  - AFO, FO, shoe modification
- Chemical denervation
  - Botulinum toxin
- Neurosurgical denervation (neurotomy of tibial nerve)
- Functional electrical stimulation
- Surgery

Improvement of gait in a stroke patient. A 7-year longitudinal study

LAURENT BENSOUSSAN, ALVINA MATHELIN, JEAN-MICHEL VITON, HERVE COLLADO & ALAIN DELARQUE

- A 44-year old man with right spastic equinovarus
- Gait analysis, FIM
- The three phase treatment
  - Botulinum toxin injection (3 yrs after stroke)
  - Selective neurotomy of the right tibial nerve (4 yrs after stroke)
  - Functional orthopaedic surgery (7 yrs after stroke)
    - Lengthening of calcaneal lig
    - Triple arthrodesis of the subtalar and transverse tarsal joints
    - Percutaneous tenotomy on toe flexors

<Disability and Rehabilitation , 2010>

- Botulinum toxin injection
  - Walking speed(-),
  - left step length(↑ , asymmetric), step width(↓)
  - Very short (1 mon)
- Selective neurotomy of the right tibial nerve
  - Walking speed(-),
  - left step length(↑ , more symmetrical), step width(↓)
  - Only temporary (8 mon)
- Functional orthopaedic surgery
  - Comfortable Walking speed(↑)
  - Step length : symmetrical, step width(↓)
  - Cast immobilization (3 months)
- Conclusions
  - BTI, TNN : a short-term, orthopaedic surgery : long-lasting effect
  - Walking barefoot without cane, stair up/down, walking outdoors

<Disability and Rehabilitation , 2010>

Effect of age, sex, and timing on correction of spastic equinovarus following cerebrovascular accident.

Namdari S, Park MJ, Baldwin K, Hosalkar HS, Keenan MA.

- Methods
  - A retrospective study 64 CVA pts with surgical corrections
  - Age, sex, duration, preoperative orthotic/ambulatory requirement
- Results
  - Deformity –correction, ambulatory score ↑
  - preoperative orthotic and ambulatory requirement ↓
- Conclusion
  - Surgical correction of SEV is effective in post-CVA pts
  - Improvement in ambulation score regardless of age, sex, or duration from CVA to surgery

< FOOT & ANKLE INTERNATIONAL, 2009 >

Claw toes

- Dystonic
  - Still flexible at the joint
  - Earlier stages, well recovered pts
  - Noncorticospinal
  - Versatile, appearing after a few step, walking backwards, without hypertonia of the toes flexors
- Spastic (rigid)
  - Fixed in unnatural position
  - Later stages, not fully recovered pts
  - Corticospinal
  - Appearing when standing up and getting worse during gait

Original article / Article original

Claw toes in hemiplegic patients after stroke

Griffe des orteils chez le patient hémiplégique après un accident vasculaire cérébral

G. Laurent, F. Valentini, K. Loiseau, D. Hennebelle, G. Robain *

- Patients and method
  - 39 hemiplegia hospitalized after a first stroke
  - Evaluation, MMT, spasticity, PASS, FAC, Barthel index
- Results
  - Claw toes
    - 46% during the first year post stroke (5 sitting, 7 standing, 6 gait)
    - Early onset (<3 months)
  - Equinus, varus foot : significant correlated
  - Very impaired dorsiflexor, intermediate BI : high prevalence
  - Etiology, the injured hemisphere, age : no correlation
- Conclusion
  - Claw toes – common, early on post-stroke, equinus, varus foot, average functional capacities

<Ann of Physical and Rehabilitation Med, 2010>

Cavovarus foot (I)

- Muscle imbalance

-> weak PB with strong TP, weak TA with strong PL

-> hindfoot varus and forefoot valgus

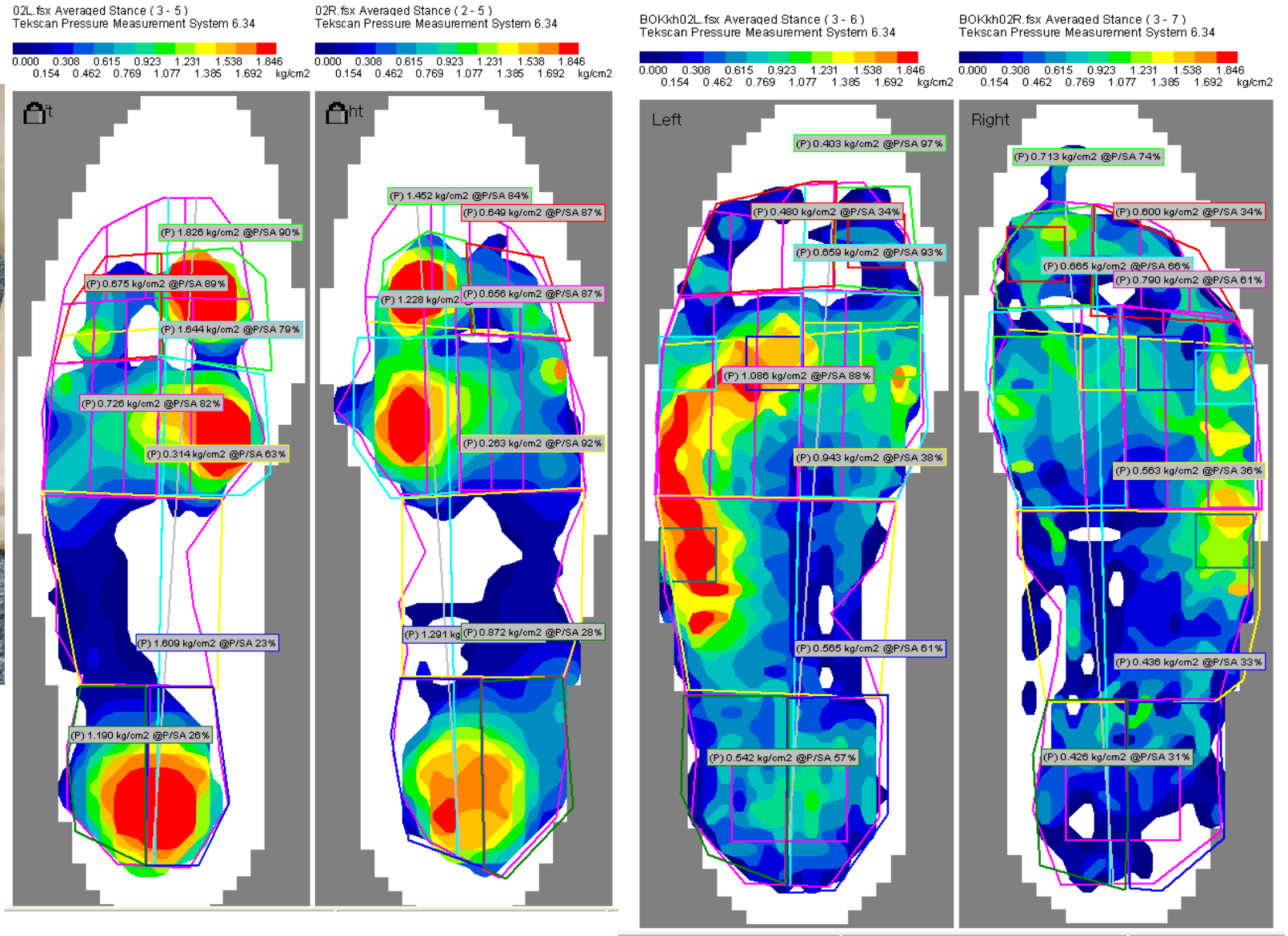
-> overload of the lateral border of the foot

-> ankle instability, peroneal tendinitis, stress fracture, metatarsalgia, secondary degenerative arthritis

Cavovarus foot (II)

- Etiology
  - Neurologic (HMSN, CP, stroke, SCI, ant. Horn cell ds)
  - Traumatic (talar neck malunion, compartment syndrome)
  - Residual clubfoot
- Physical examination
  - Inspection
  - ROM of joint
  - Coleman block test
    - Forefoot-driven hindfoot varus
    - Intrinsic or tibialis posterior muscle-driven hindfoot varus
- Orthoses
  - Metatarsal pad with metatarsal head cut, semirigid
  - A high boot or an off-the-shelf ankle brace
  - AFO d/t prevent foot drop
  - Night splint d/t progressive contracture

<Rt hemiplegia d/t Stroke>



Spinal cord injury/multiple sclerosis

Pes cavus and claw toes deformity in patients with spinal cord injury and multiple sclerosis (I)

- To study the prevalence of the foot deformity in SCI/MS
  To discuss the pathogenesis of these foot deformities
- 80 SCI (aged 25 to 68)
  - Duration 2 mon to 17yr
  - 51 pts : spastic, (all but one – mobile equinus deformity)
    : 8 pts - pes cavus or claw toes
    - cervicl in two, dorsal in six
  - 29 flaccid pts : no pes cavus or claw toes
- 20 MS (aged 33 to 48)
  - Duration 3 to 17 yr
  - All pts : spastic and equinus
  - One : pes cavus, another : pes cavus + claw toes

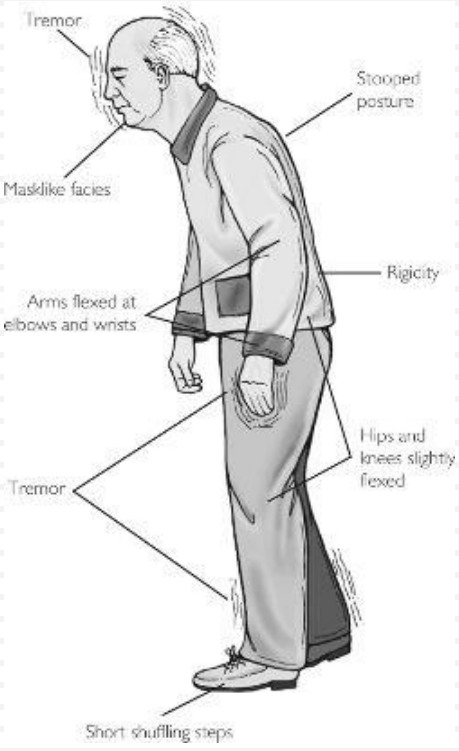
<Paraplegia 16, 1978-1979>

Pes cavus and claw toes deformity in patients with spinal cord injury and multiple sclerosis(II)

- Extent of excitatory skin areas
  - Pes cavus and claw toe : proximal to the knee
  - Without foot deformity : distal to the knee
- EMG
  - Spasms in specific muscles
  - Order of recruitment : TA, hamstring, GCM, TP, EHL, RF
- Conclusion
  - Pes cavus, claw toes
    - 10%
    - Complication of severe spasticity
    - Predominant activity of TA + the reflex activity of the EHL

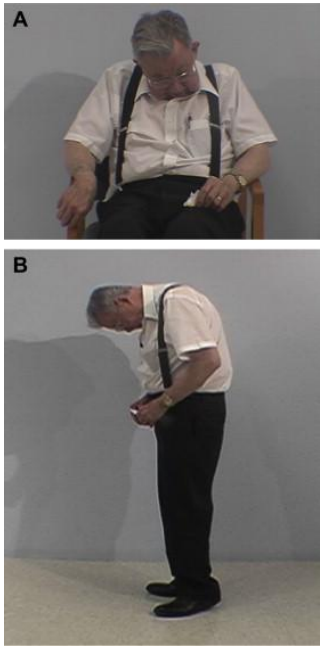
<Paraplegia 16, 1978-1979>

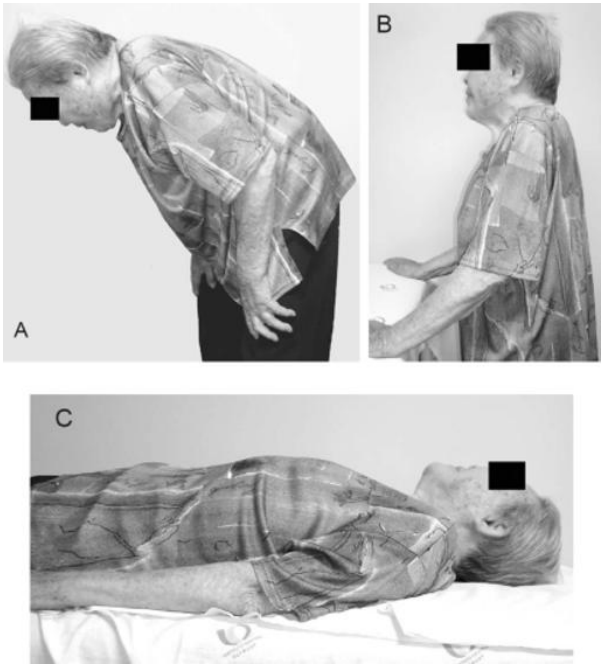
Parkinson's ds, MSA, PSP



Joint and skeletal deformities

- Striatal hand
- Striatal foot
- Dropped head (anterocollis)
- Trunk flexion (camptocormia)
- Scoliosis



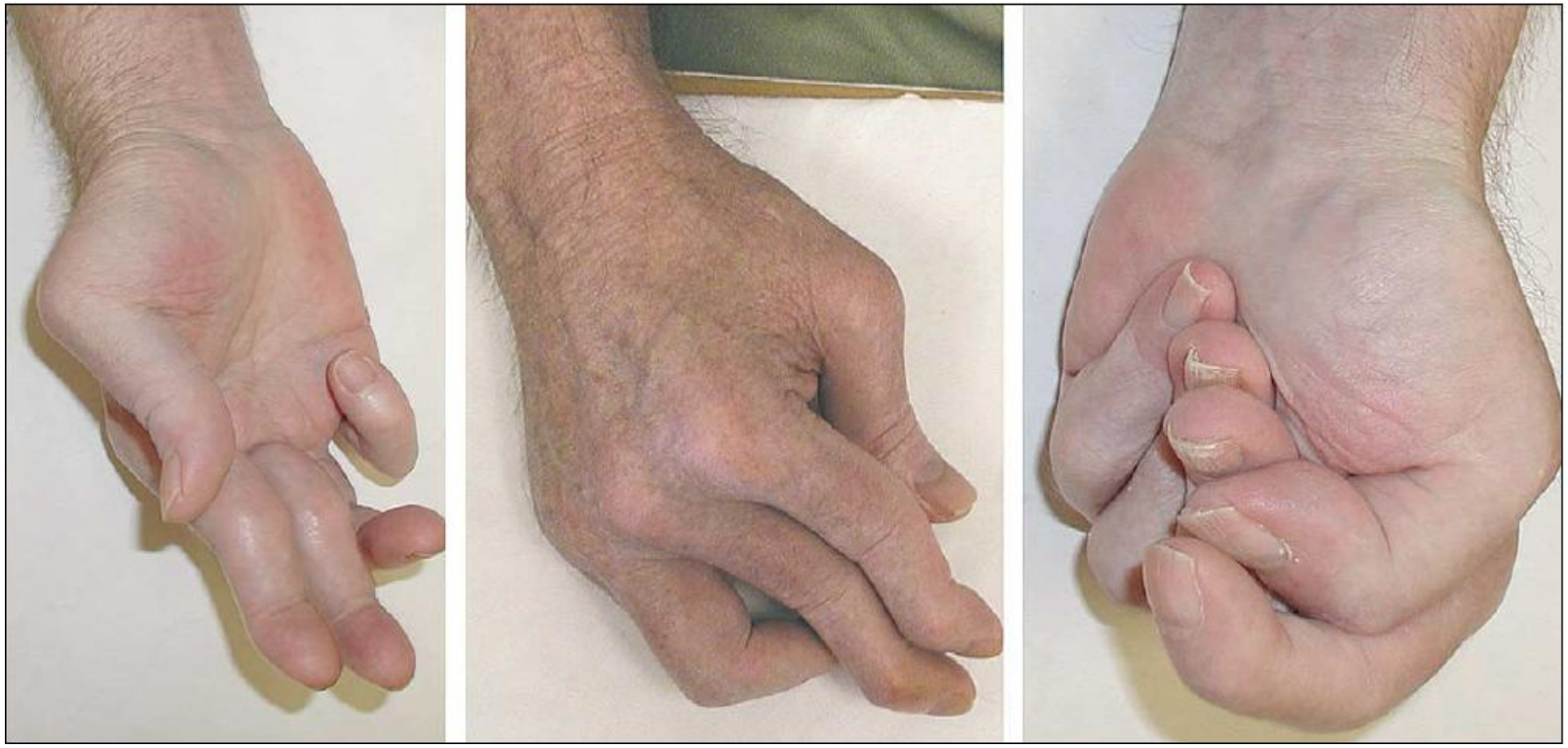


Striatal deformities (I)

- Originally described in 1864
- Pathology in the neostriatum(putamen and caudate)
- Misdiagnosis in absence of tremor, bradykinesia and rigidity
  - Hand deformities : Rheumatoid arthritis
  - Equinovarus foot deformity : orthopedic problem
  - Toe extension - Barbinski sign
- Advanced PD, early stages of PD, other parkinsonian ds

Striatal deformities (II)

- Synonym
  - Dystonic foot response of parkinsonism, dystonic claudication, striatal toe, hitchhiker's great toe, pseudo-rheumatoid deformity, pseudo-barbinski
- Part of the primary disease process
- One of the earliest signs in untreated pt
- Pathogenesis
  - Unknown
  - Combination of dystonia, decreased striatal dopamine, fibrosis with alterations in soft-ts plasticity and visco-elasticity



- Striatal hand
  - Flexion of the MCP
  - extension of PIP, flexion of DIP
  - ulnar hand deviation
- Striatal foot
  - Great toe extension
  - flexion of the remaning toes
  - equinovarus foot
  - Pain, impaired the ability to stand and walk, skin ulcer
  - Striatal toes

< RA vs Stratal abnormalities>

Features	Rheumatoid arthritis	Striatal abnormalities
Pathophysiological features	Proliferative synovitis, autoimmunity, microbial initiator	Non-inflammatory, dystonic features, soft-tissue elastic changes
Joints	Swollen, warm, painful, pannus formation	Painful, contractures
Radiographic changes	Joint effusions, juxta-articular osteopenia with erosions, narrowed joint space with loss of cartilage	Normal
Mobility	Morning stiffness, decreased range of motion (active and passive)	Fixed deformity, may respond to levodopa or botulinum toxin
Distribution	Generally symmetrical joint involvement, polyarticular	In most cases develops on one side with ipsilateral emergence of cardinal PD signs
Genetics	Association with HLA DR4 or DR1	Seems to be more common in juvenile-onset PD
Extra-articular features	Cutaneous and visceral rheumatoid nodules, increased serum rheumatoid factor, synovial cysts, vasculitis, episcleritis	Rigidity, bradykinesia, tremor

Joint and Skeletal Deformities in Parkinson's Disease, Multiple System Atrophy, and Progressive Supranuclear Palsy

Ramsey Ashour, BS,[1] and Joseph Jankovic, MD[2*]

[1]University of Texas Medical Branch, Galveston, Texas, USA
[2]Department of Neurology, Baylor College of Medicine, Houston, Texas, USA

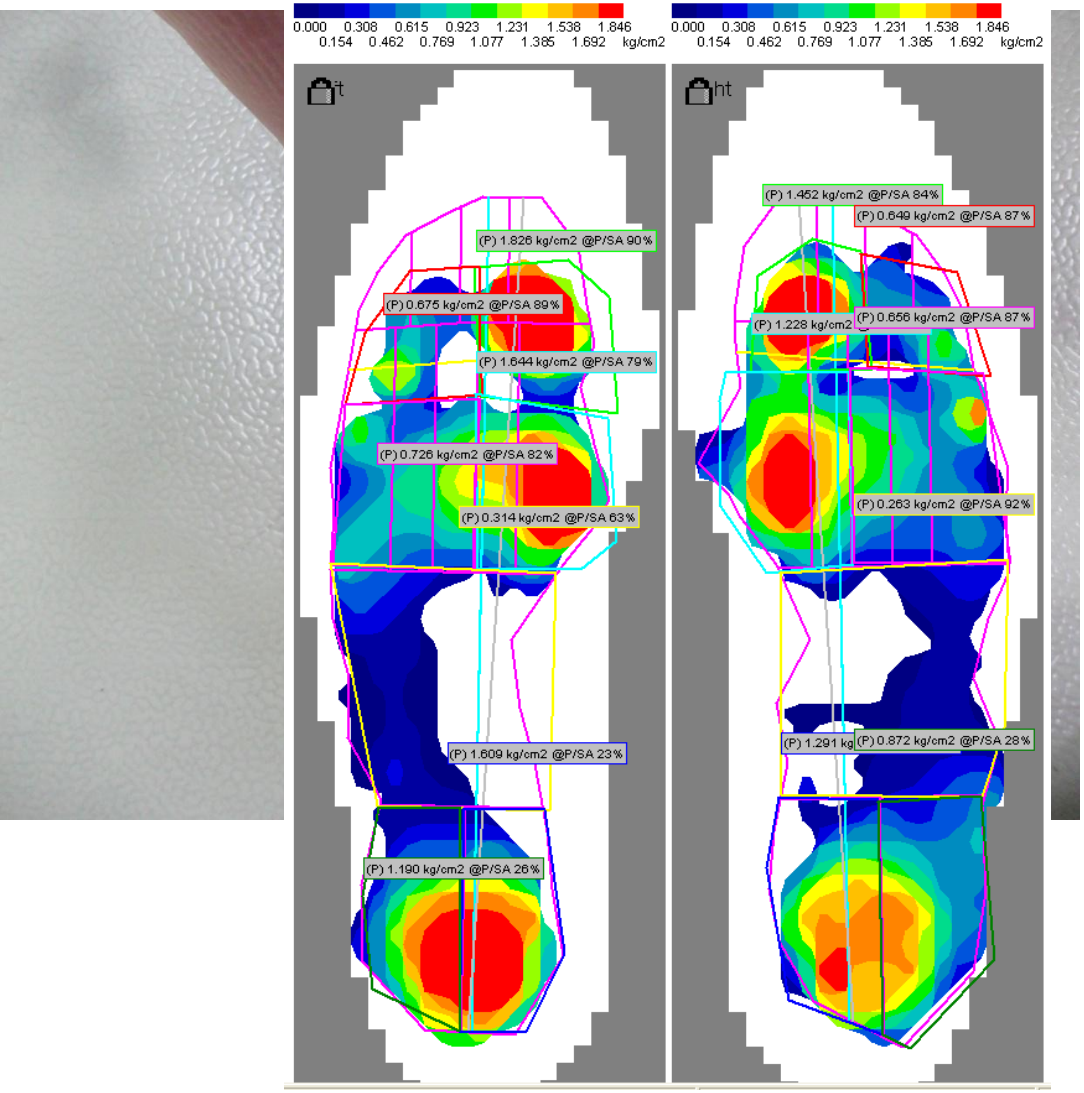
- 202 patients
  - 36.1% : joint and skeletal deformities
  - Striatal hand & foot : 13.4% (hand/foot =8.4 %/5.9%)
  - Striatal deformities -12.8%(PD), 26.3%(MSA), 5.3%(PSP)
  - M=F, Younger
  - An earlier age at onset of PD sx
  - Higher mean Unified Parkinson's Ds rating scale scores
  - More often treated with levodopa
  - Independent of disease duration
  - Correlated with the side of initial parkinsonian symptoms, hand(100%), foot(83.3%)
- Deformities : common, under-recognized, marked functional disability

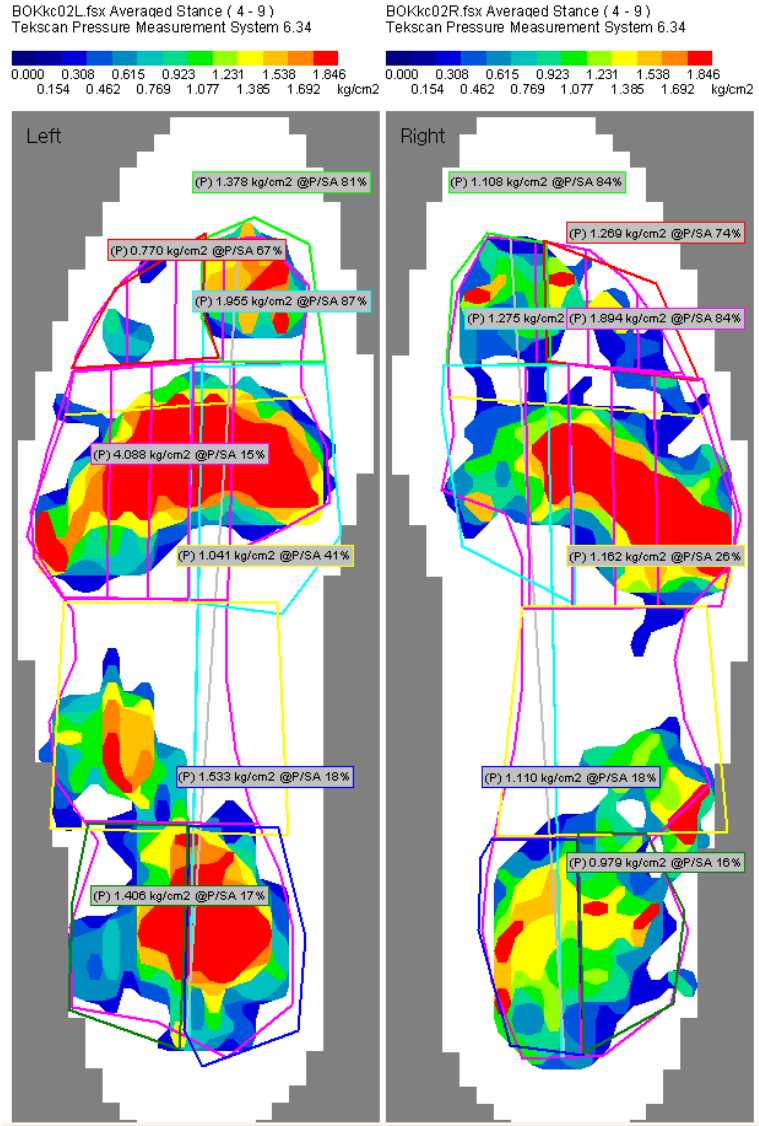
<Movement disorder, 2006>

Treatment

- Anti-parkinsonian drug – less predictable
  - Levodopa (? complete resolution)
  - Anticholinergics, baclofen, benzodiazepines
- Botulinum toxin injection
  - Focal dystonia, striatal toes
- Orthopaedi surgical interventions
  - Split TA tendon transfer with extrinsic toe-flexor release and achilles tendon lengthening
- Neurosurgical treatment
  - Stereotactic pallidotomy, thalamotomy, deep-brain stimulation

<Parkinson's ds>





Take home message

- Stroke
  - Varus during swing – EDL should be slectively strengthened
  - Equinovarus Tx – orthotheses, BTI, neurotmy, orthopaedic surgery
  - Claw toes – common, early onset
  - Cavovarus
- SCI/MS
  - Equinus, pes cavus, claw toes
- Parkinson's ds
  - Striatal hand and foot
  - One of the earliest signs in untreated Pt
  - Part of the primary ds process

Thank you for your attention !