Collège Hospitalier et Universitaire de Chirurgie Pédiatrique

DESC de Chirurgie Pédiatrique

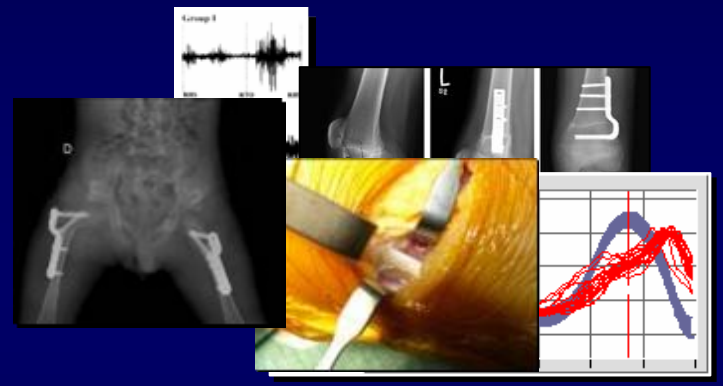
Session de Septembre 2009 - PARIS

Traitement orthopédique et traitement chirurgical dans la Paralysie Cérébrale (PC)

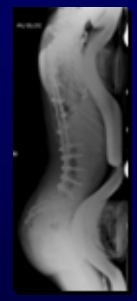
Dr Thierry HAUMONT

PLAN

- Généralités de prise en charge de ces enfants PC et leur famille
- Traitement des membres inférieurs
  - chirurgical
  - orthopédique



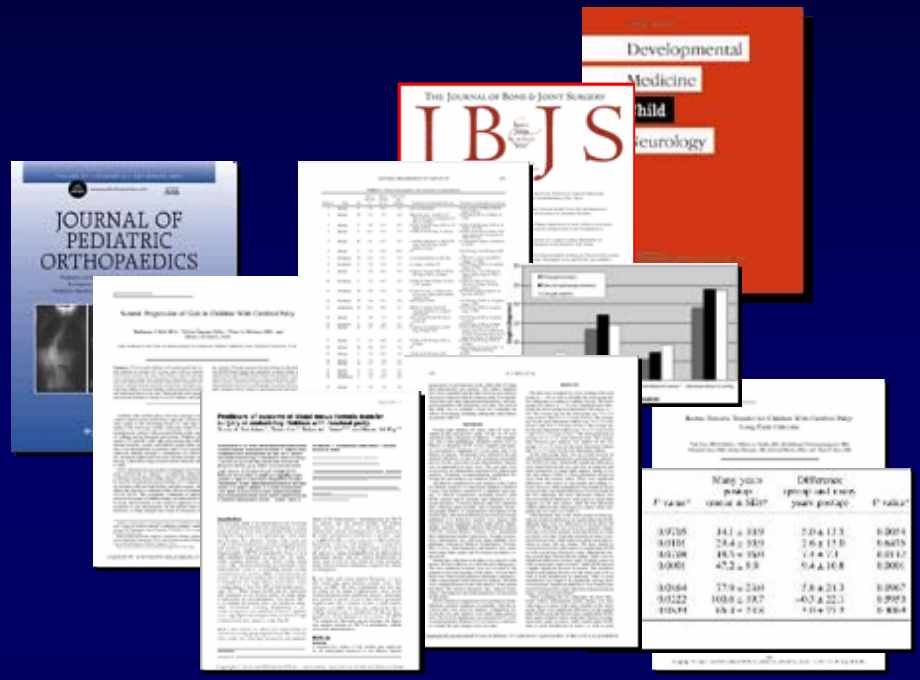
- Traitement du rachis
  - chirurgical
  - orthopédique



- Traitement des membres supérieur

Généralités

- Publications scientifiques



- Comprendre des principes éprouvés pour appréhender ces patients, leurs familles et leur pathologie

Généralités

Il ne s'agit pas de la correction chirurgicale d'une anomalie isolée mais du suivi à long terme d'un jeune patient.

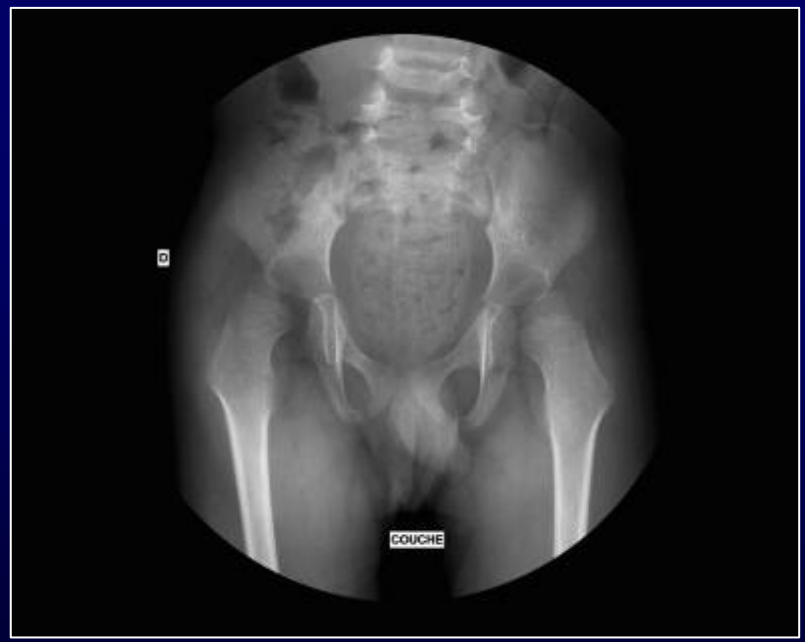
Le chirurgien doit s'inscrire dans la séquence :

- Acceptation de la maladie
- Acceptation des thérapeutes (consultation multidisciplinaire)
- Acceptation des thérapeutiques

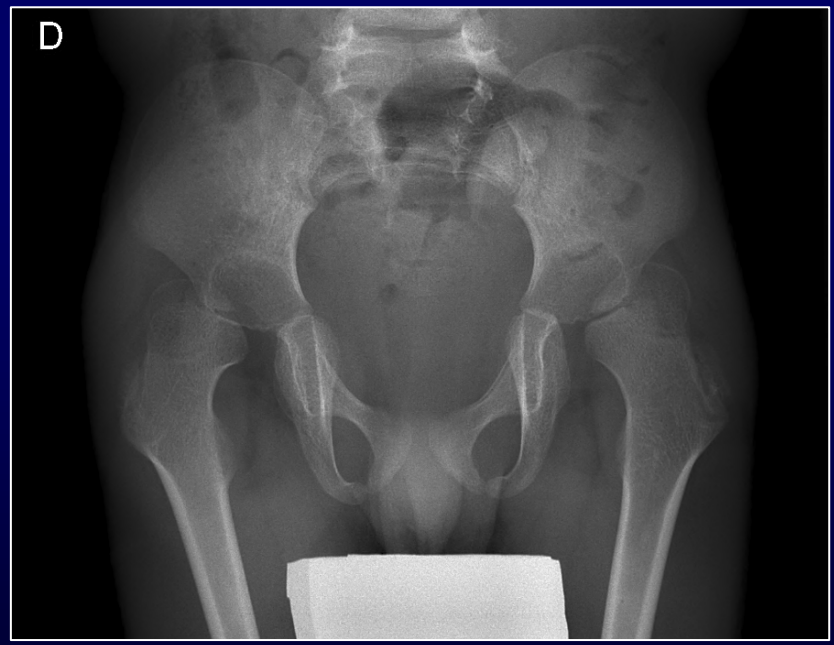
Généralités

Donc éviter de proposer une intervention chirurgicale à la 1ère Cs:

l'intervention orthopédique dans la PC n'est JAMAIS une urgence.



2005



2007

Généralités

- Qu'attend le patient de l'intervention

  Qu'attendent les parents de l'intervention

- Résultats attendus

  Principales complications potentielles

  Suites opératoires

Généralités

- Equipe multidisciplinaire.

- Chirurgien seul à faire face à la responsabilité chirurgicale.

Traitement chirurgical des membres inférieurs

- Spasticité
- Rétractions (allongement, ténotomie)
- Déséquilibres musculaires (transfert musculaire)
- Troubles architecturaux osseux et articulaires
  (troubles torsionnels, troubles d'axe, luxation de hanche)

Traitement chirurgical des membres inférieurs

Rétractions

- La spasticité génère

  → réduction de 50% de la croissance en longueur des fibres musculaires

  → réduction de la surface de section donc force moins importante

  → Plus de fibres de type I (fibres lentes) - Contraction musculaire plus lent

- Temps de latence nerveuse périphérique plus lente

Muscle growth in normal and spastic mice
I. Ziv, N. Blackburn, M. Rang, J. Koreska
Dev Med Child Neurol 1984. 26: 94-99

Traitement chirurgical des membres inférieurs

Rétractions

La rétraction est une déformation tertiaire faisant suite à la spasticité

→ La rétraction augmente la force passive

→ mais réduit la force active (longueur des fibres musculaires)

Donc course réduite avec contraction plus lente pour une force réduite

Traitement chirurgical : Complexe musculo-tendineux

Rétractions

- Allongement
- Ténotomie

Anomalie d'activité +/- Rétractions

- Transfert tendineux

Traitement chirurgical des membres inférieurs

Rétractions: Indication ténotomie

<u>Ténotomie</u> est utilisée pour :

- *<u>réduire</u> une <u>position vicieuse</u> (marchant ou non marchant)*
- <u>neutraliser l'action</u> d'un muscle délétère

<u>Affaibli le muscle considéré</u> :

- *Attention aux enfants déambulants*
- Attention aux muscles biarticulaires

Traitement chirurgical des membres inférieurs

Rétractions: Indication allongement

Allongement est utilisée pour :

- *redonner une course normale à un muscle*
- conserver sa fonction

Traitement chirurgical des membres inférieurs

Indications transfert musculaire

- Supprimer l'action délétère d'un muscle qui a une action inappropriée se contractant le plus souvent à un moment inopportun.
- Restituer
    - une position
    - ou un mouvement si le transfert est actif
- Le plus souvent chez l'enfant marchant
- Parfois aussi chez l'enfant non marchant

Cheville – Triceps sural

Soléaire (genou fléchi)

Gastrocnémiens (genou tendu)

Cheville – Triceps sural

Triceps sural

De l'Orthomorphie - 1828

réussir, par ce seul moyen, à effacer solidement les difformités dont il s'agit, tient à celle d'opérer ce même changement dans la nutrition des muscles; que, partout où il se prononce, on peut espérer d'y réussir, même après la période de l'enfance, comme nous pourrions en citer des exemples; que, si les effets de ce changement ne se manifestent pas bientôt, on ne peut rien espérer de l'extension seule, même à un âge peu avancé. C'est dans un cas de cette dernière espèce, que nous avons pratiqué avec succès la section du tendon d'Achille (1); opération dont il n'y avait encore qu'un autre exemple, et qui n'avait pas été érigée en méthode, ni soumise à des préceptes réguliers, et que nous persistons à regarder comme une ressource qui peut avoir son utilité (2). Ce

(1) Voyez Chirurgie clinique de Montpellier, Tom. I : Mém. sur les *Pied-bots*.

(2) Le rédacteur d'un journal de la Capitale, qui s'est refusé à insérer une réclamation de notre part sur l'inconvenance de son langage à notre égard, s'étonne que nous ayions *sérieusement proposé* cette opération. S'il s'était donné la peine de lire l'histoire que nous en avons publiée, il aurait vu

n'est donc pas par l'âge du sujet, mais bien par la possibilité de changer l'ordre de la nutrition dans les muscles trop courts, que l'on doit décider la question de la possibilité de guérir un *pied-bot* par la seule extension; de la nécessité de recourir à la section des tendons qui opposent une résistance invincible; et cette résistance doit être bien constatée par des épreuves suffisamment prolongées et puissantes, avant de décider, sans retour, la ressource à laquelle il convient de s'arrêter.

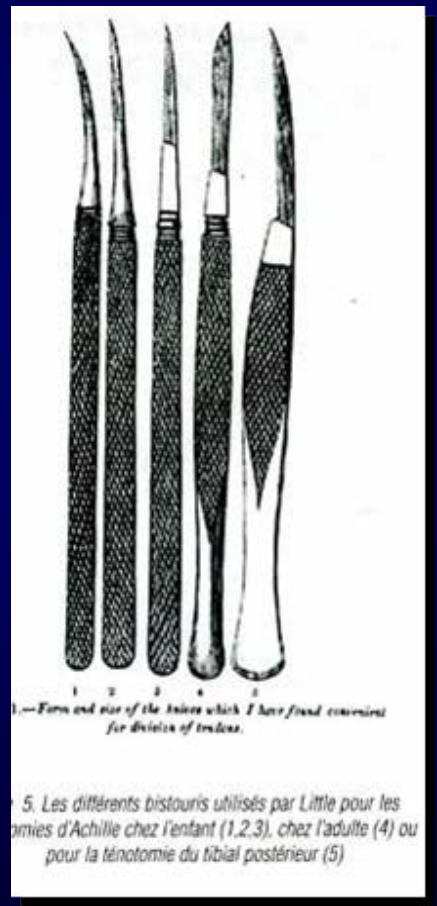
§. CCCXXVII. Si l'on croit de l'opération fondée sur de bo

que nous ne l'avons pas seulement encore pratiquée avec un succès com teurs de la Revue médicale ont t opération était une faute; mais ils en discuté le mérite. Nos collaborateurs chose en gens qui n'ont pas rencontr nous pouvons leur assurer qu'il y a est d'insurmontables. Ces cas sont ra nous pouvons, comme tout autre, ples de guérison à plus de 55 ans, recours à cette ressource; mais, il où elle sera précieuse.

Little 1810-1894

- *Pied varus équin gauche*
- *Rencontre avec JM Delpech*
- *Intervention par Strohmeyer (Hanovre)*
  - *Percutanée*
- *1ère ténotomie britannique :*

  20 février 1837
  - *L'intervention ne dure pas plus « d'un quart de minutes »*



5. Les différents bistouris utilisés par Little pour les ...mies d'Achille chez l'enfant (1,2,3), chez l'adulte (4) ou pour la ténotomie du tibial postérieur (5)

Triceps sural

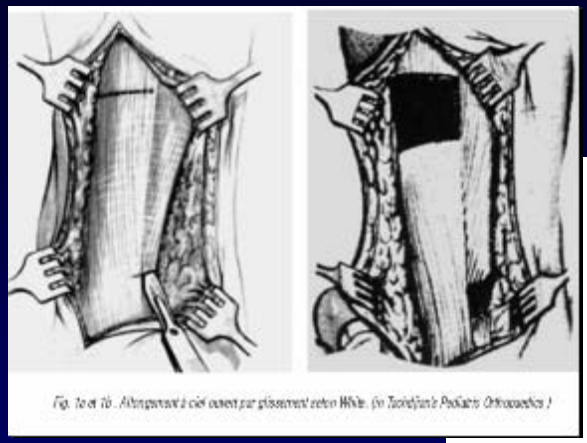


Fig. 1a et 1b . Allongement à ciel ouvert par glissement selon White. (in Tachdjian's Pediatric Orthopaedics)

Rétractions: Allongement

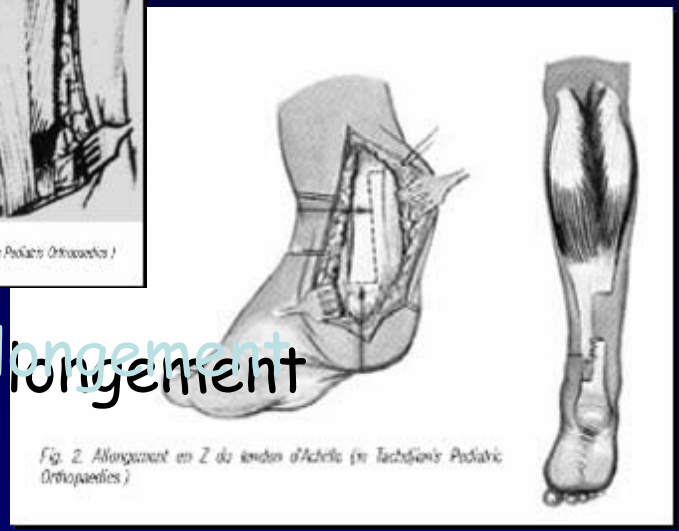


Fig. 2. Allongement en Z du tendon d'Achille (in Tachdjian's Pediatric Orthopaedics)

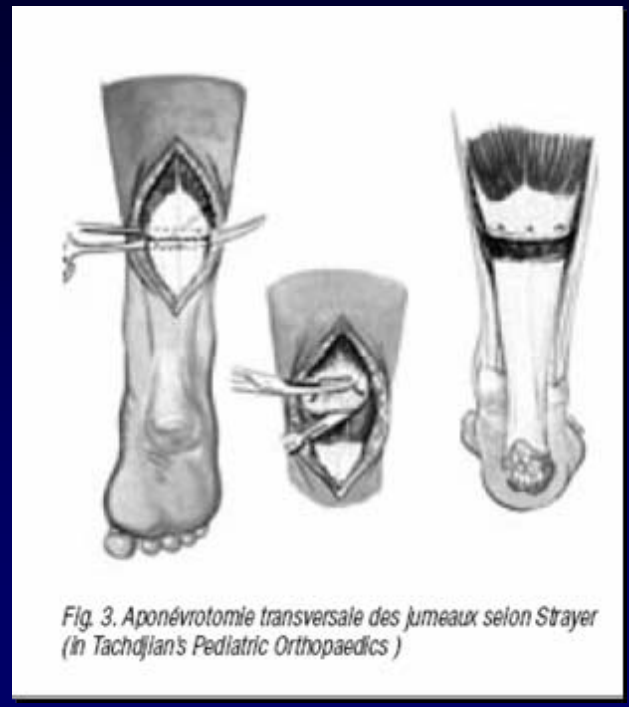


Fig. 3. Aponévrotomie transversale des jumeaux selon Strayer (in Tachdjian's Pediatric Orthopaedics)

Fig. 5 : Aponévrotomie en chevron de Vulpius, avec section du raphé médian du muscle soléaire (in Tachdjian's Pediatric Orthopaedic)

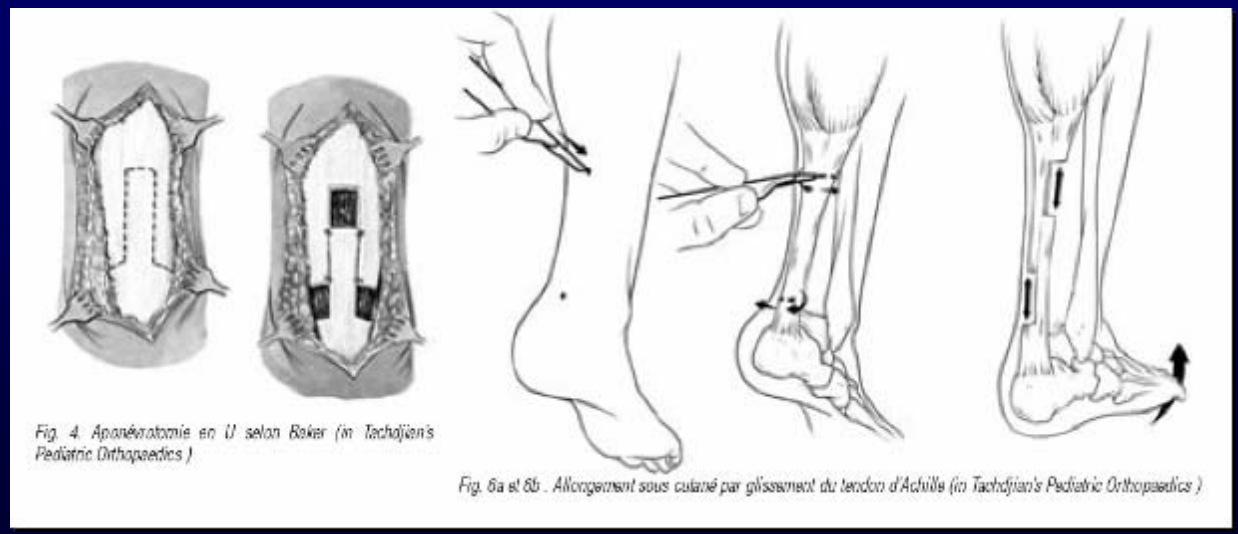


Fig. 4. Aponévrotomie en U selon Baker (in Tachdjian's Pediatric Orthopaedics)

Fig. 6a et 6b . Allongement sous cutané par glissement du tendon d'Achille (in Tachdjian's Pediatric Orthopaedics)

Pierre Journeau « Gazette du GEOP » 2003; 10:7-9

Rétractions: Allongement

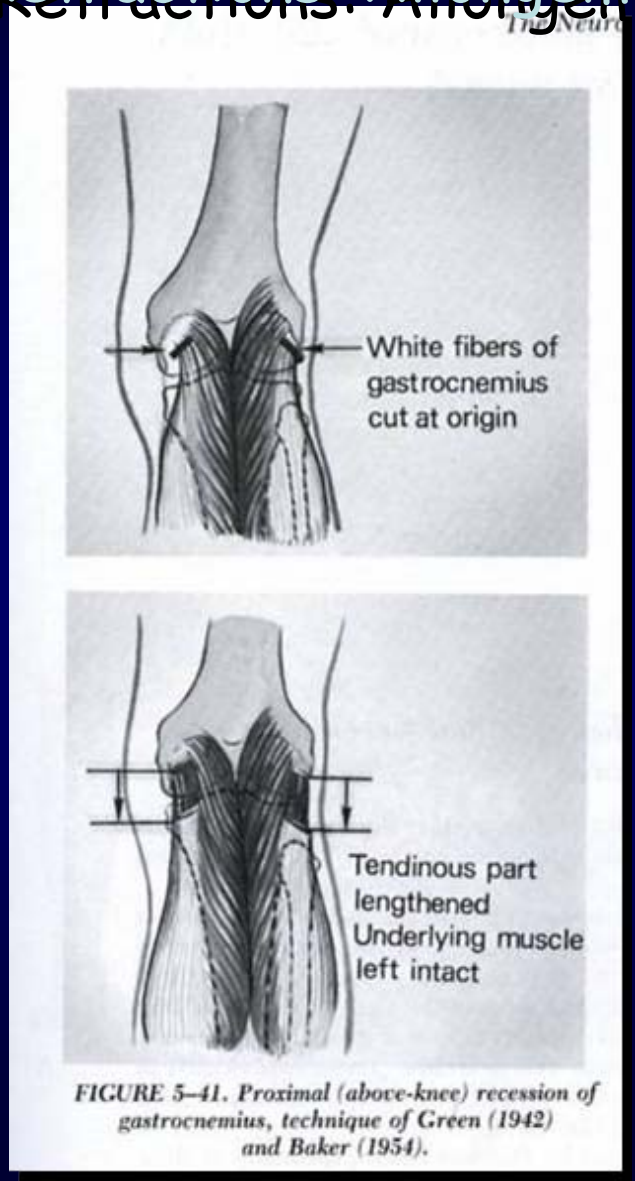
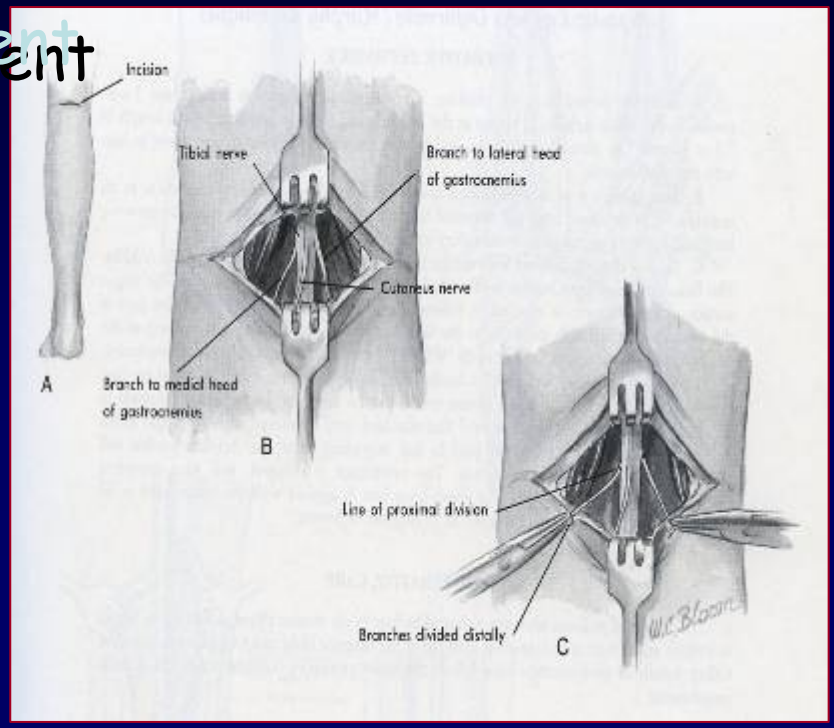
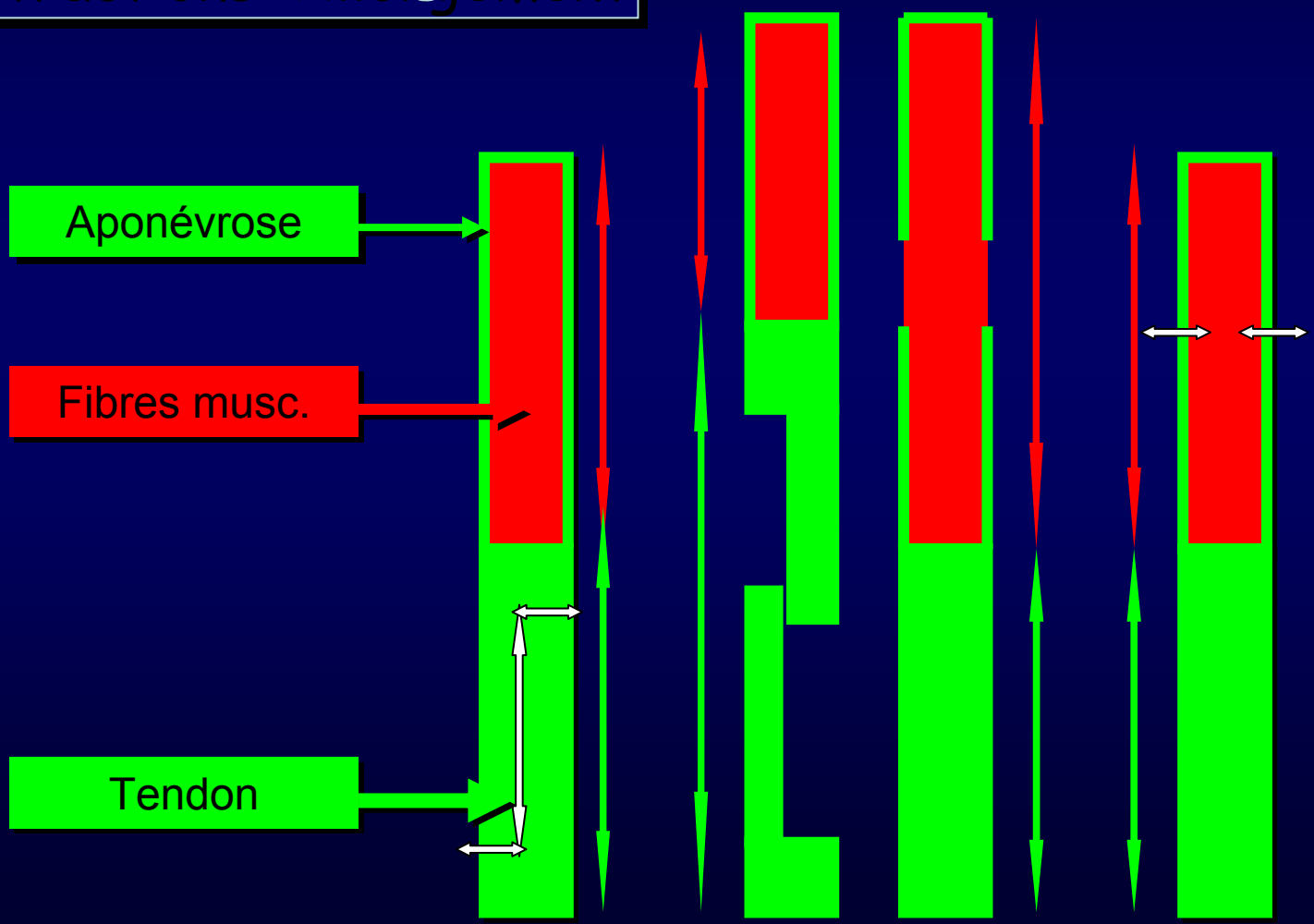


FIGURE 5–41. Proximal (above-knee) recession of gastrocnemius, technique of Green (1942) and Baker (1954).



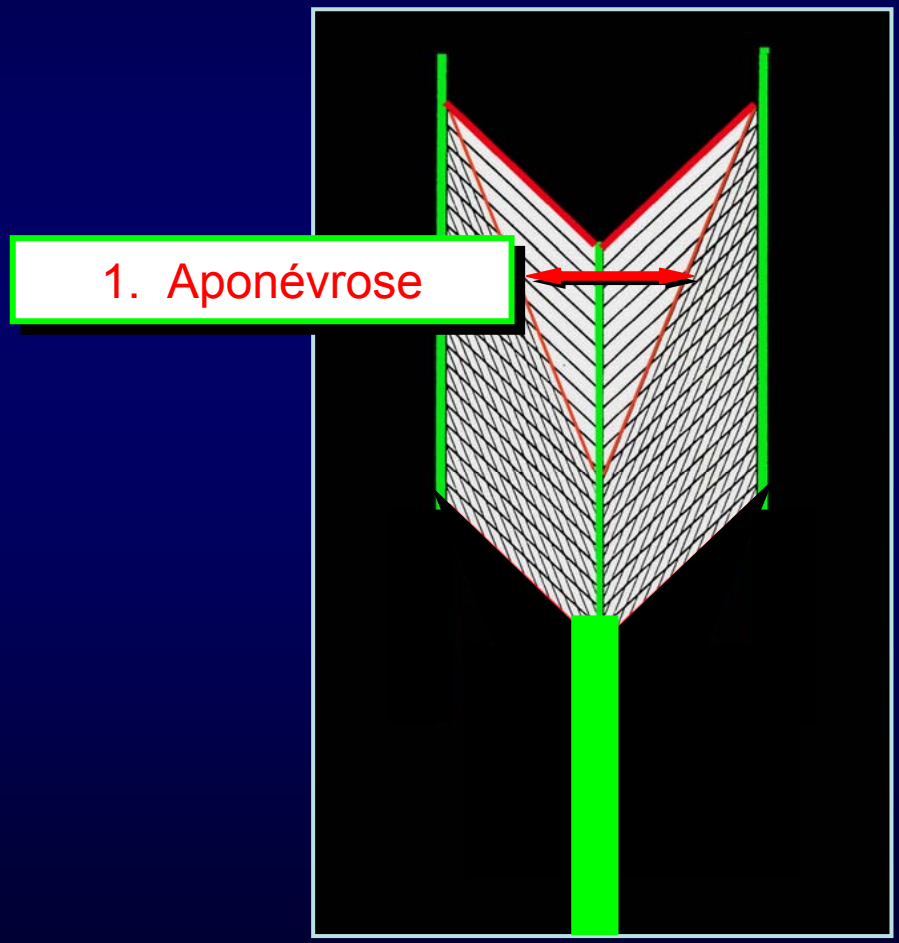
Traitement chirurgical des membres inférieurs

Rétractions: Allongement



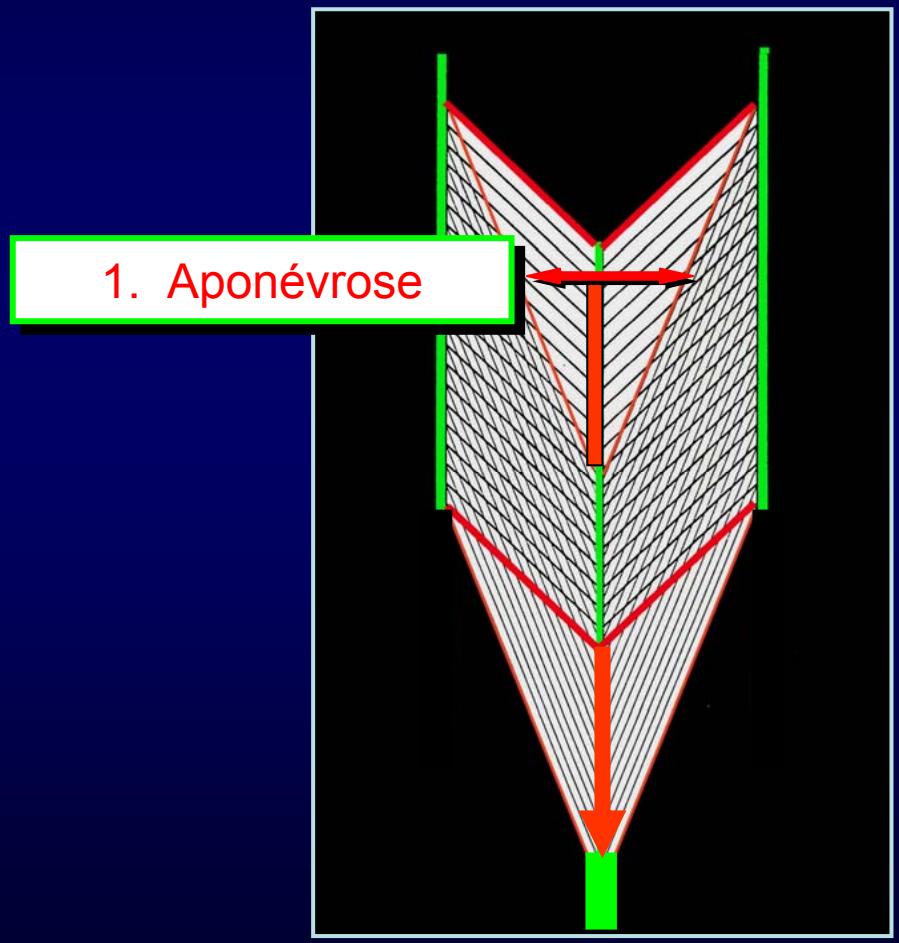
Traitement chirurgical des membres inférieurs

Rétractions: Allongement



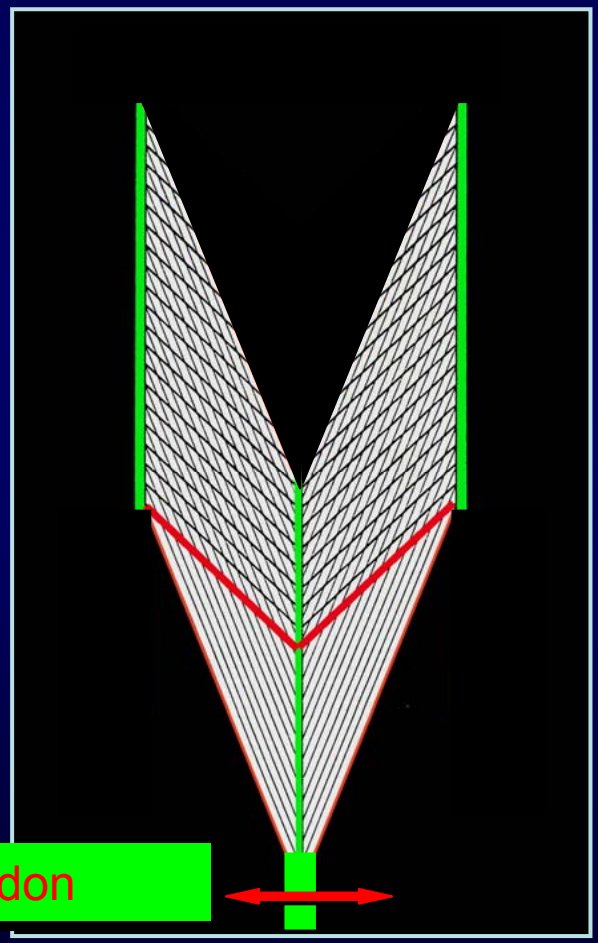
Traitement chirurgical des membres inférieurs

Rétractions: Allongement



Traitement chirurgical des membres inférieurs

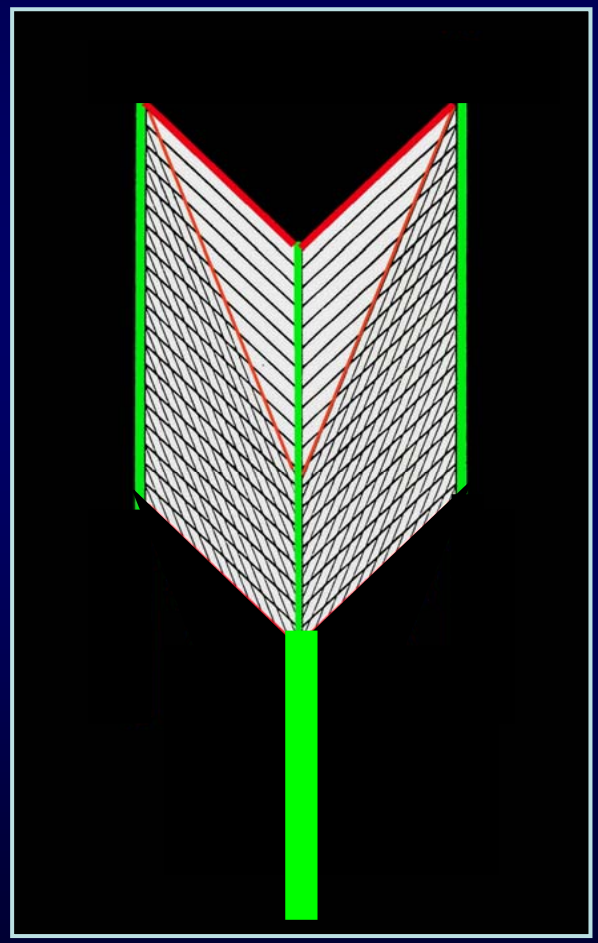
Rétractions: Allongement



1. Tendon

Traitement chirurgical des membres inférieurs

Rétractions: Allongement



Rétractions: Allongement

- Fibres de type I : UM lente
  - Métabolisme oxydatif +++
  - Contraction lente, continue, sans fatigue
  - Fibres de petit Ø : peu de force

- Fibres de type IIa, IIb : UM rapide ou très rapide
  - Métabolisme anaérobie prédominant
  - Contraction rapide, forte, fatigable

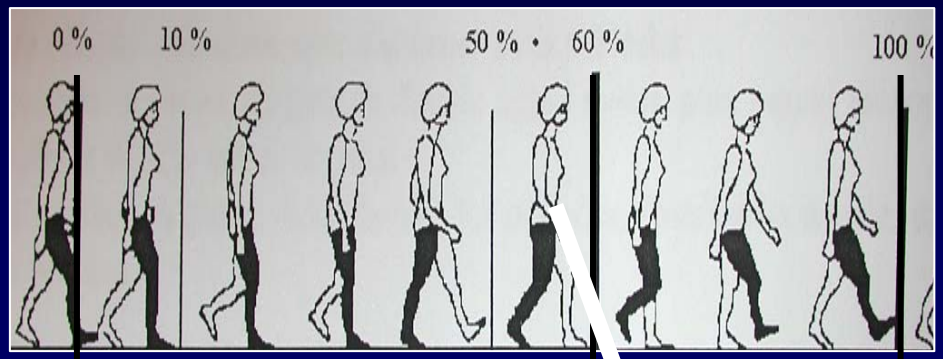
Triceps

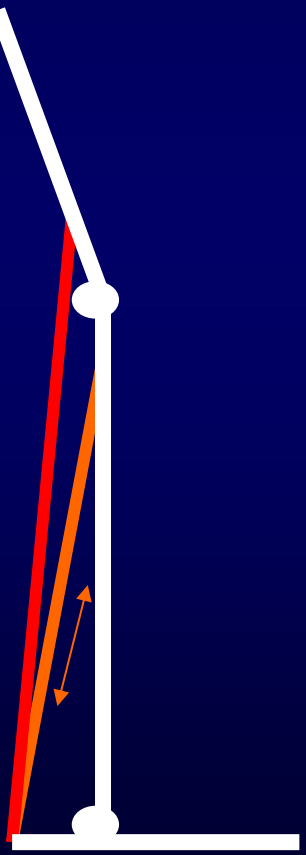
Rétractions: Allongement

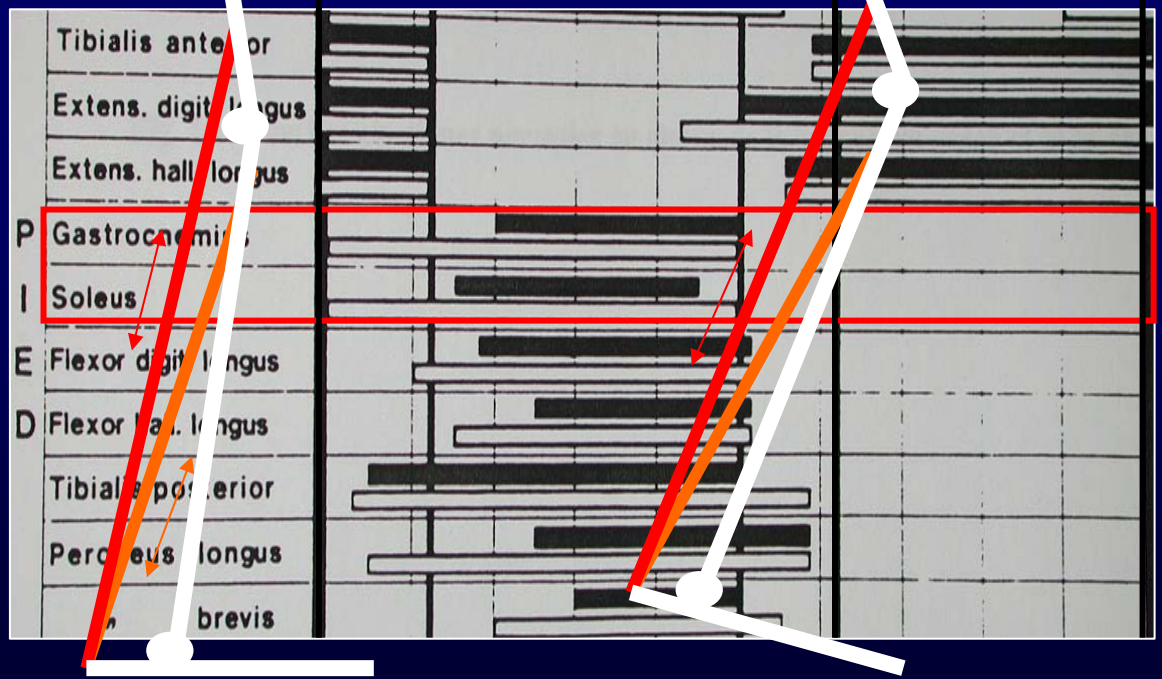
- *Soléaire:*
  - Fibres de type I
  - Contraction lente, continue, sans fatigue
  - Fibres de petit Ø : peu de force
- *Gasctrocnémiens:*
  - Fibres de type II
  - Contraction rapide, forte, fatigable

Traitement chirurgical des membres inférieurs

Rétractions: Allongement

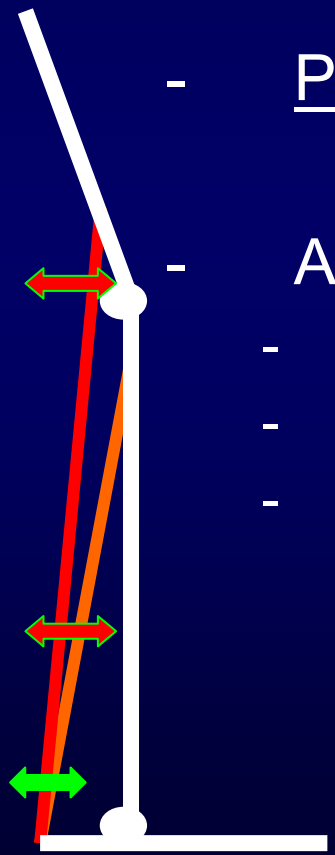






Traitement chirurgical des membres inférieurs

Rétractions: Allongement



- Privilégier +++ l'allongement aponévrotique
- Allongement tendineux
  - Eventuellement si très bonne force musculaire (ado)
  - Jamais chez le sujet avec force musculaire faible
  - Ne pas faire chez le petit enfant

Traitement chirurgical des membres inférieurs

Rétractions: Ténotomie

<u>Ténotomie</u> peut être utilisée pour :

- Droit fémoral

Rétraction - Droit fémoral

Traitement chirurgical des membres inférieurs

Rétractions: Ténotomie

Quadriplégique grabataire:

Flexum de hanche (Proximale)

*Diplégique marchant **

Flexion de genou en phase d'oscillation

(Stiff knee gait)

Attention: le muscle n'est pas une « ficelle rétractile »

Traitement chirurgical des membres inférieurs

Indications transfert musculaire: Rectus Femoris

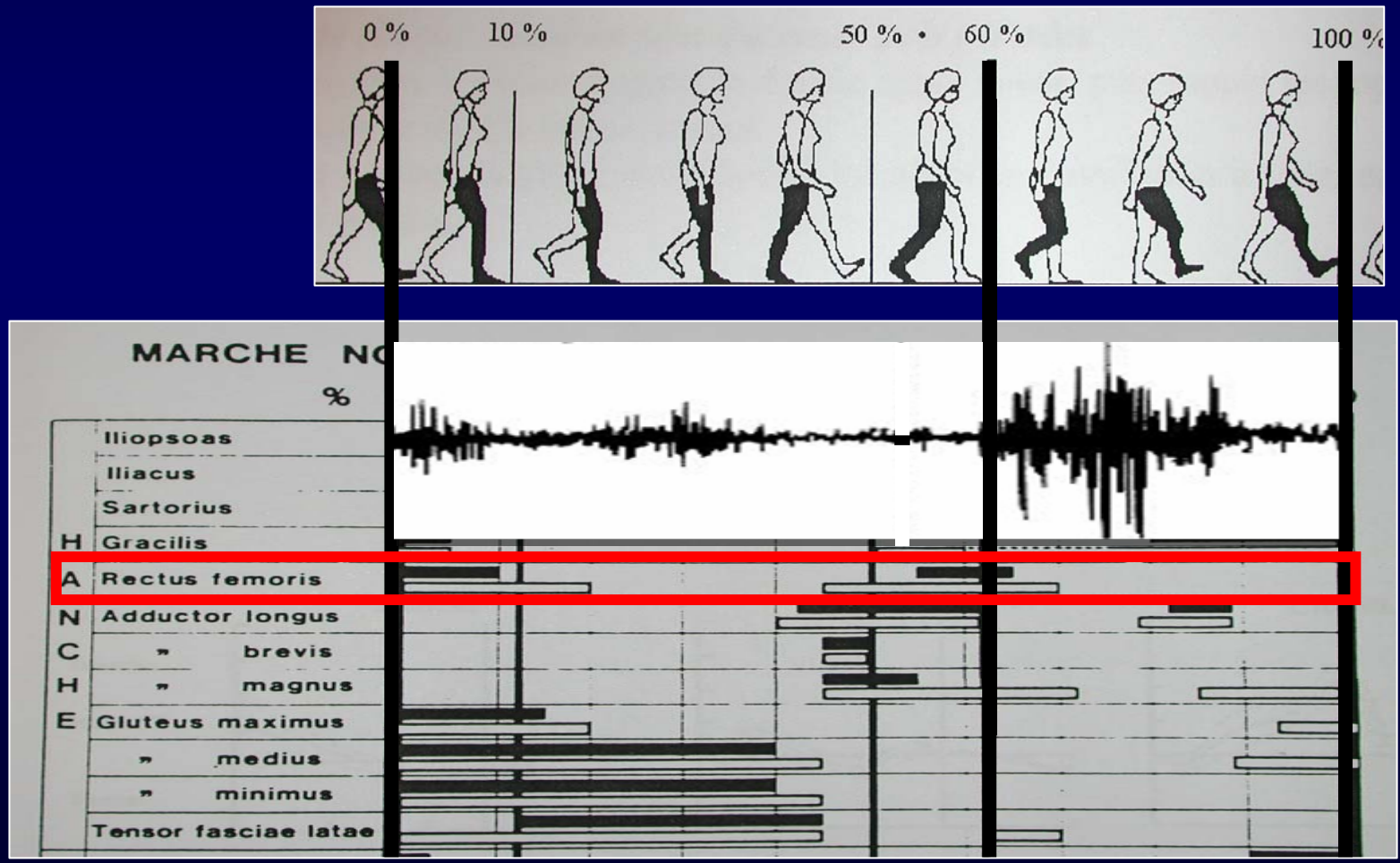
L'action inappropriée du rectus femoris est transferée pour améliorer la flexion du genou en phase oscillante.

Treatment of stiff-knee gait in cerebral palsy: a comparison by gait analysis of distal rectus femoris transfer versus proximal rectus release.
Sutherland DH, Santi M, Abel MF.
J Pediatr Orthop 1990 Jul;10(4):433-41.

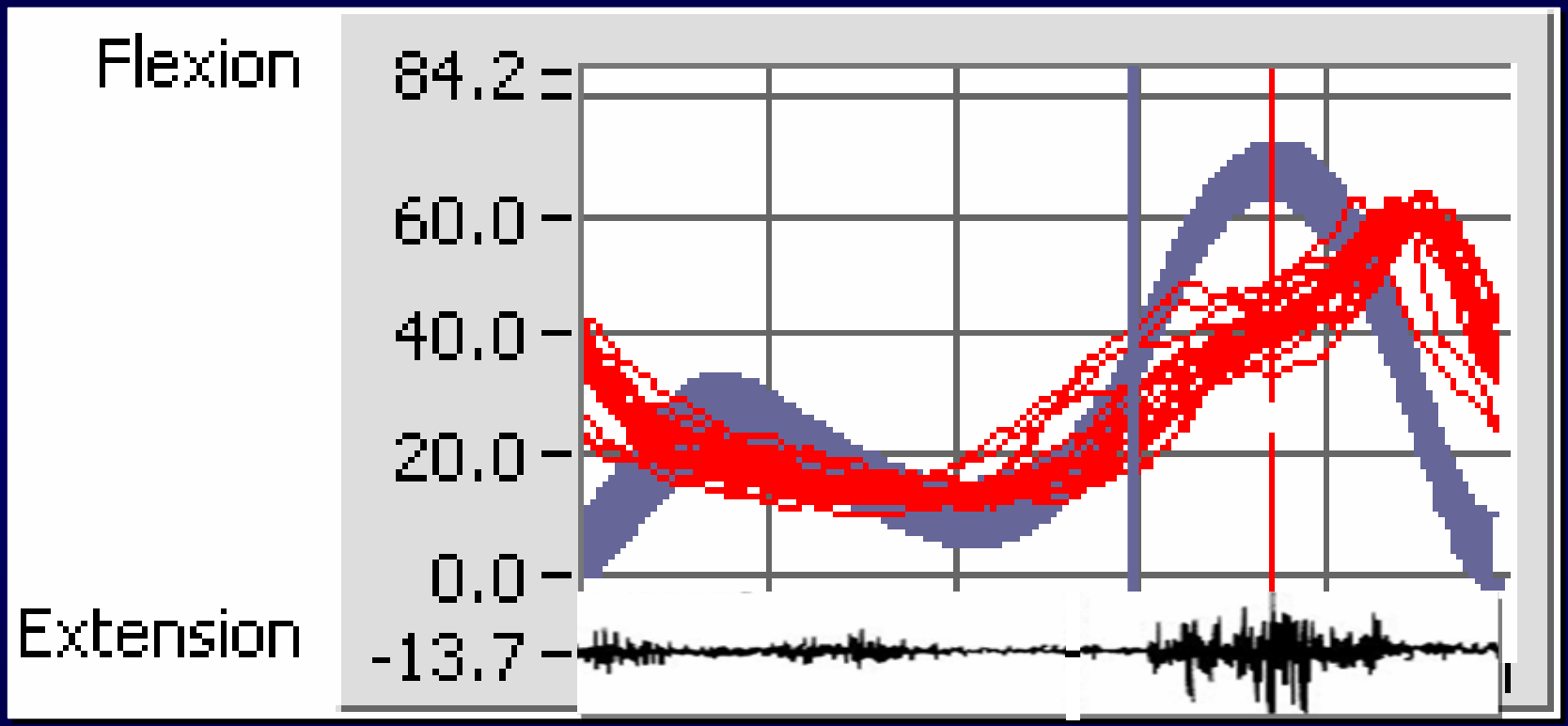
Rectus femoris surgery in children with cerebral palsy. Part II: A comparison between the effect of transfer and release of the distal rectus femoris on knee motion.
Ounpuu S, Muik E, Davis RB, III, Gage JR, DeLuca PA.
J Pediatr Orthop 1993 May;13(3):331-5.

Traitement chirurgical des membres inférieurs

Indications transfert musculaire: Rectus Femoris



Indications transfert musculaire: Rectus Femoris



Cinématique

Traitement chirurgical des membres inférieurs

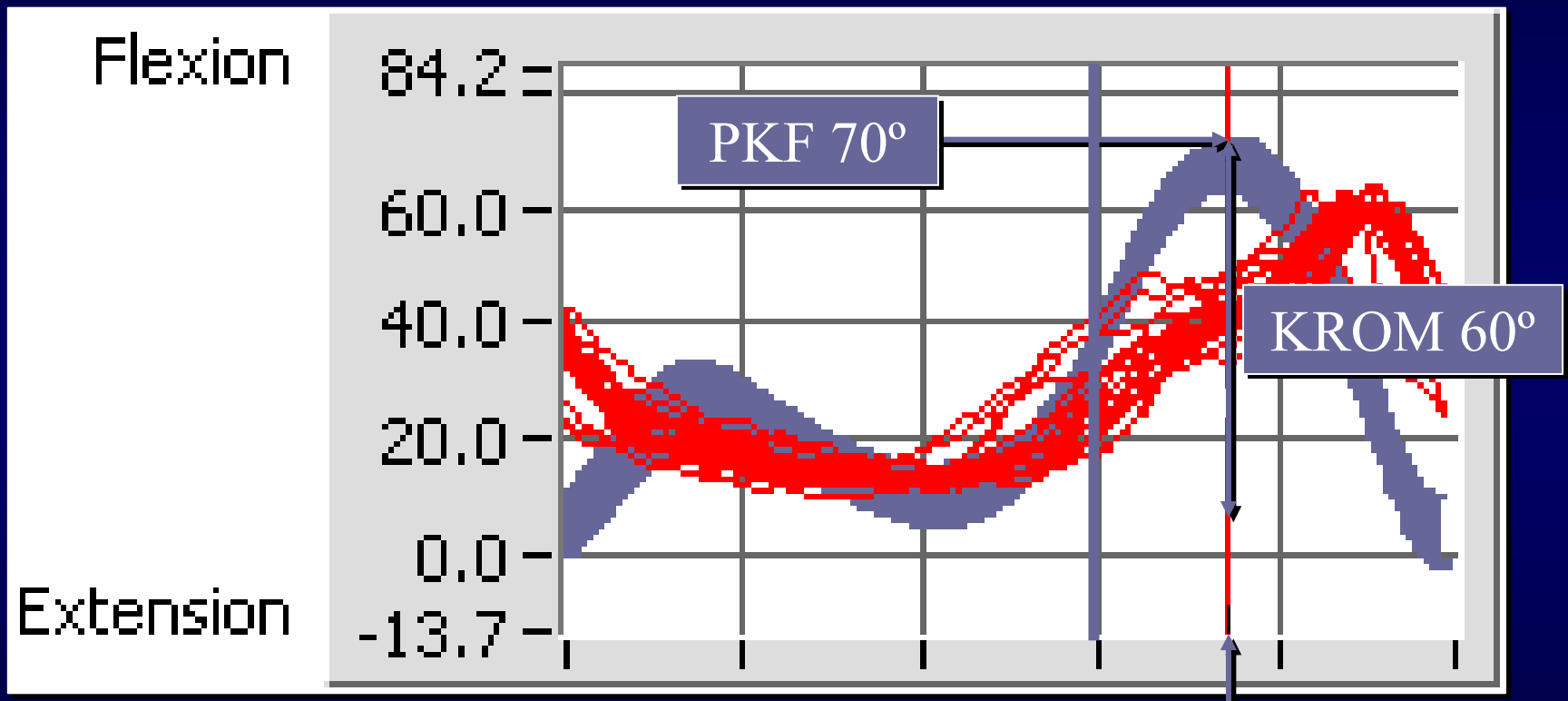
Indications transfert musculaire: Rectus Femoris

Améliorer la clairance du pied

Evite en particulier l'accrochage du pied et les chutes lors de la marche sur terrain irrégulier lors de la montée d'une marche…

Clinique

Indications transfert musculaire: Rectus Femoris



Cinématique

Traitement chirurgical des membres inférieurs

Indications transfert musculaire: Rectus Femoris

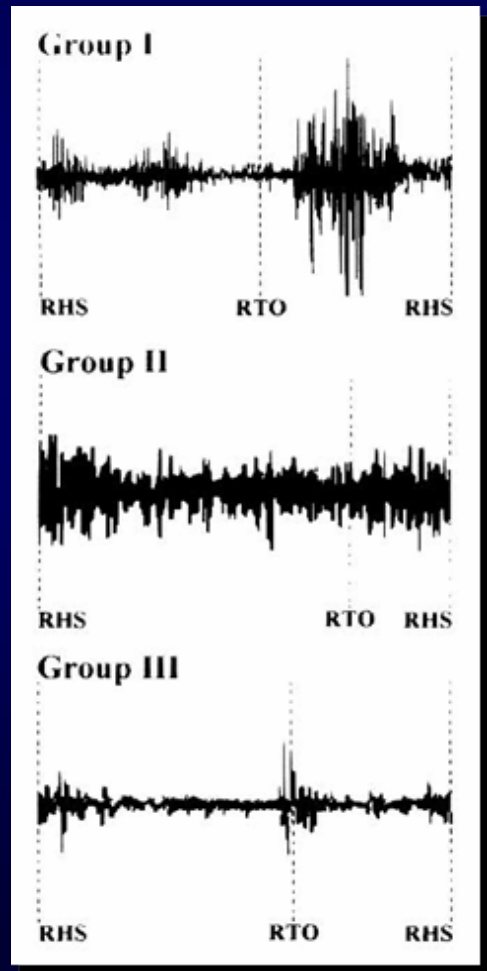
Très bonnes indications pour les groupes I et II

26°

18°

12°

EMG



The effect of rectus EMG patterns on the outcome of rectus femoris transfers.
Miller F, Cardoso DR, Lipton GE, Albarracin JP, Dabney KW, Castagno P.
J Pediatr Orthop 1997 Sep;17(5):603-7.

Traitement chirurgical des membres inférieurs

Indications transfert musculaire: Rectus Femoris

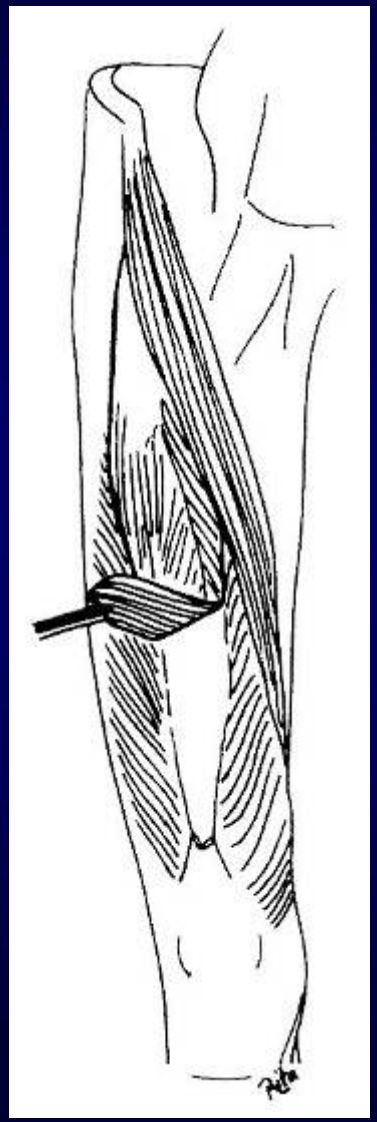
Le transfert peut se faire sur:

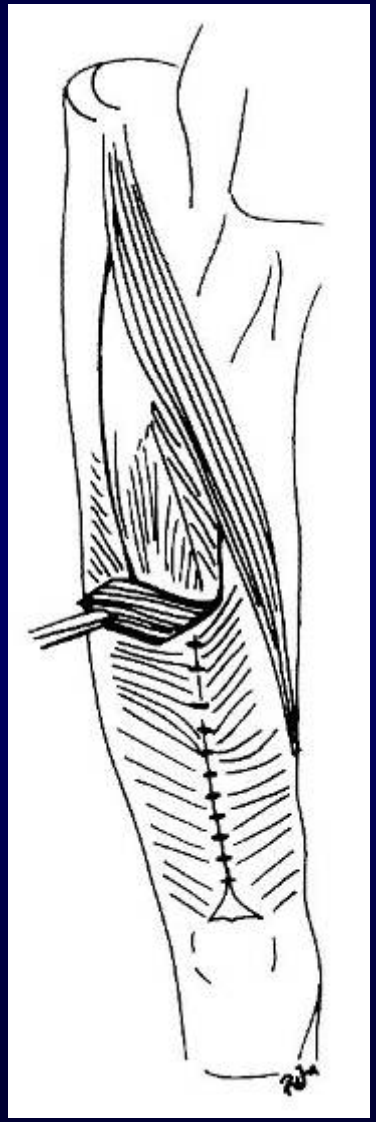
- Gracile
- Sartorius
- Semi-tendineux
- Biceps

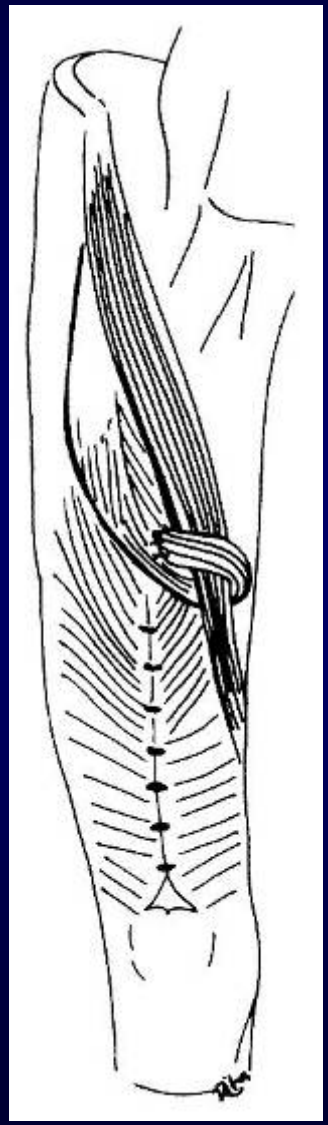
Rectus femoris surgery in children with cerebral palsy. Part I: The effect of rectus femoris transfer location on knee motion.
Ounpuu S, Muik E, Davis RB, III, Gage JR, DeLuca PA.

J Pediatr Orthop 1993 May;13(3):325-30.

Transfert musculaire: Rectus Femoris sur Sartorius







Littérature

Résultats Long terme du transfert musculaire RF ?

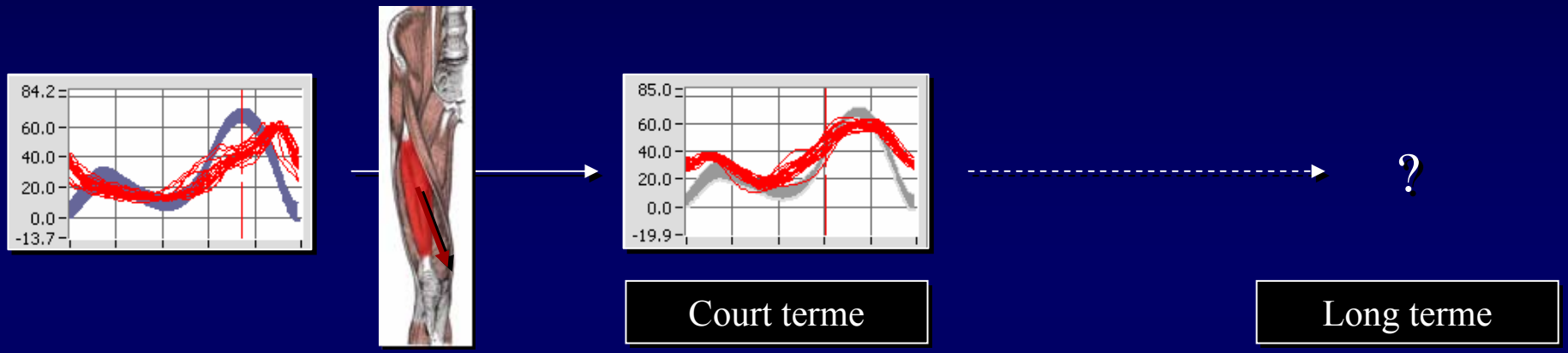
Rectus femoris transfer for children with cerebral palsy: long-term outcome.
Saw A, Smith PA, Sirirungruangsarn Y, Chen S, Hassani S, Harris G, et al.
J Pediatr Orthop 2003 Sep;23(5):672-8.

18 patients (26 membres)
4.6 ans recul
PKF and KROM

Progression of knee joint kinematics in children with cerebral palsy with and without rectus femoris transfers: a long-term follow up.
Moreau N, Tinsley S, Li L.
Gait Posture 2005 Oct;22(2):132-7.

28 patients (5O membres)
3 ans recul
PKF, KROM, TiPKF, KE ES

Question



Quels résultats à long terme du transfert du rectus femoris ?

Results

Table II: Outcomes after rectus femoris transfer in children with stiff knee gait.

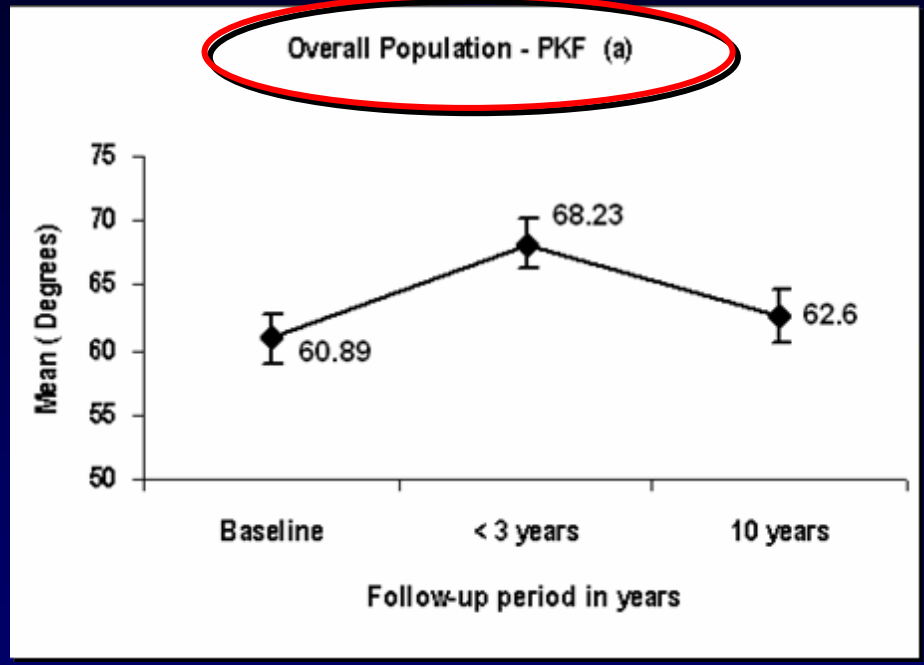
	Pre-operative		Post-operative Short-term		Post-operative Long-term		F value	*df*	*p* value
Kinematics	Mean	SD	Mean	SD	Mean	SD	F value	*df*	*p* value
PKF	60.89	14.03	68.23	10.08	62.6	10.78	16.78	1	<0.001
ROM	49.26	16.15	51.62	14.95	47.19	14.01	3.95	1	0.02
TiPKF	81	7	80	5	79	6	4.43	1	0.01
VKF	210.19	108.16	286.74	135.54	238.74	115.34	20.45	1	<0.001
	Mean	SD	Mean	SD	Mean	SD	χ^2	*df*	*p* value
Toe Drag*	1.92	0.27	1.29	0.46	1.33	0.47	109.8	2	<0.001

* The toe drag was estimating using Friedman parametric alternative to repeated measure ANOVA. The mean rank was 2.61 for the pre-operative toe drag, 1.66 for <3-year follow-up, and 1.73 for 10-year follow-up.

7.5 years ± 2.3 (4.6 to 13.1)
Gross Motor Function Measure (**GMFM**): 56.8 ± 20.7 (12.8 to 92.3)
Gait Velocity (**GV**): 67.8 ± 31.6 (11.9 to 126.9)

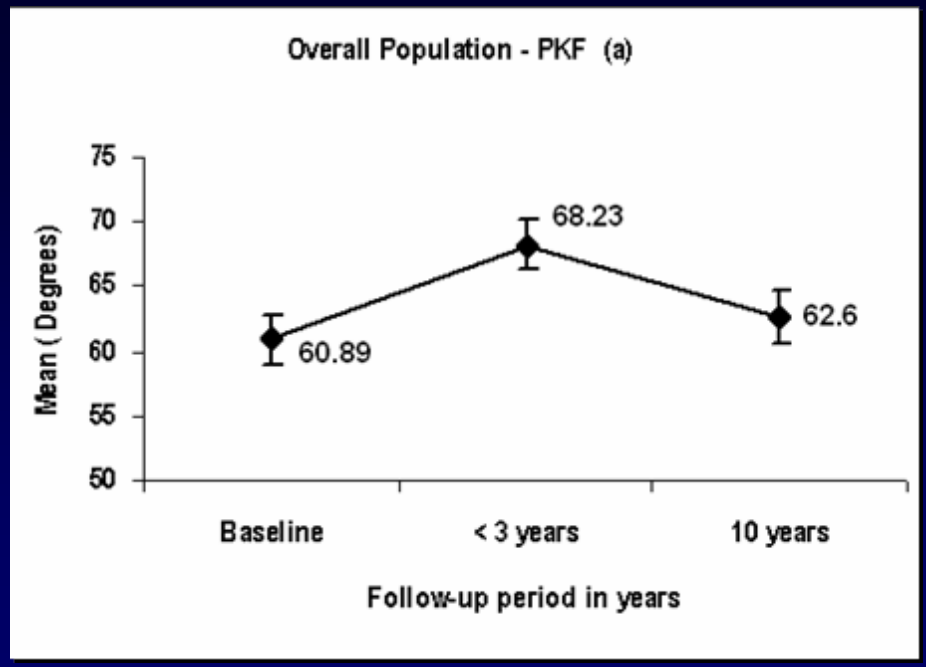
Results

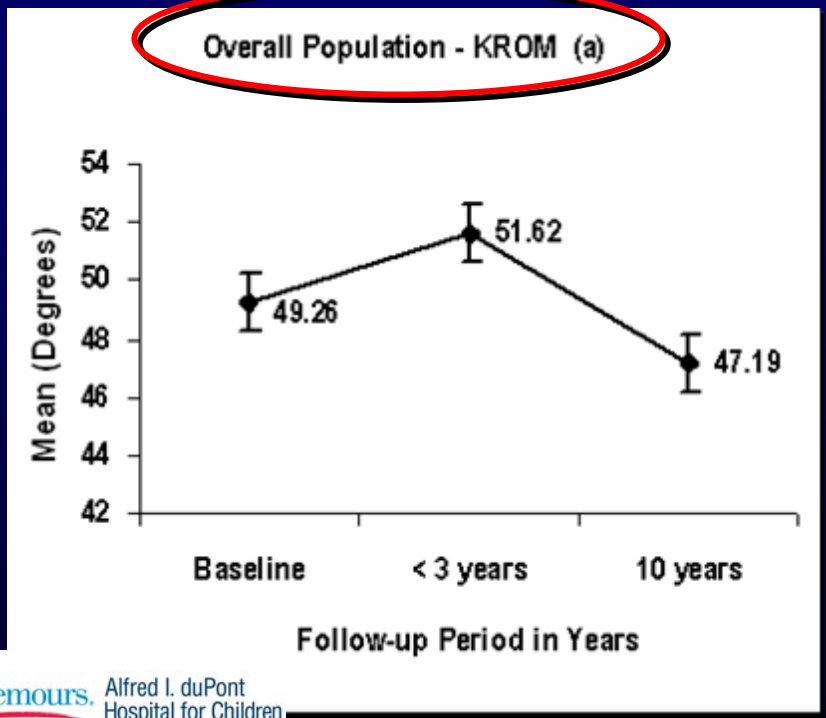
Population globale



Results

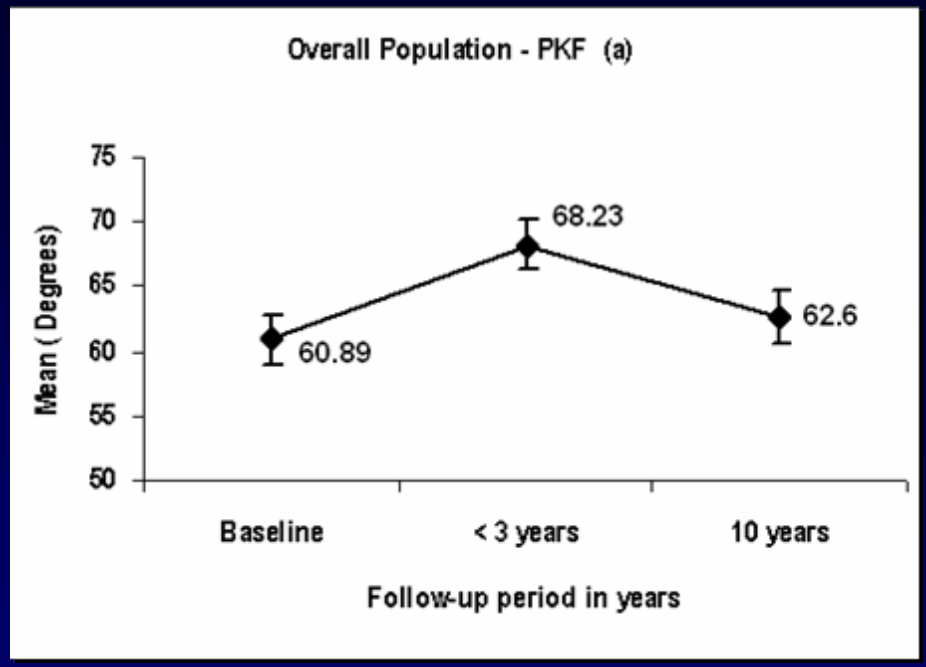
Population globale

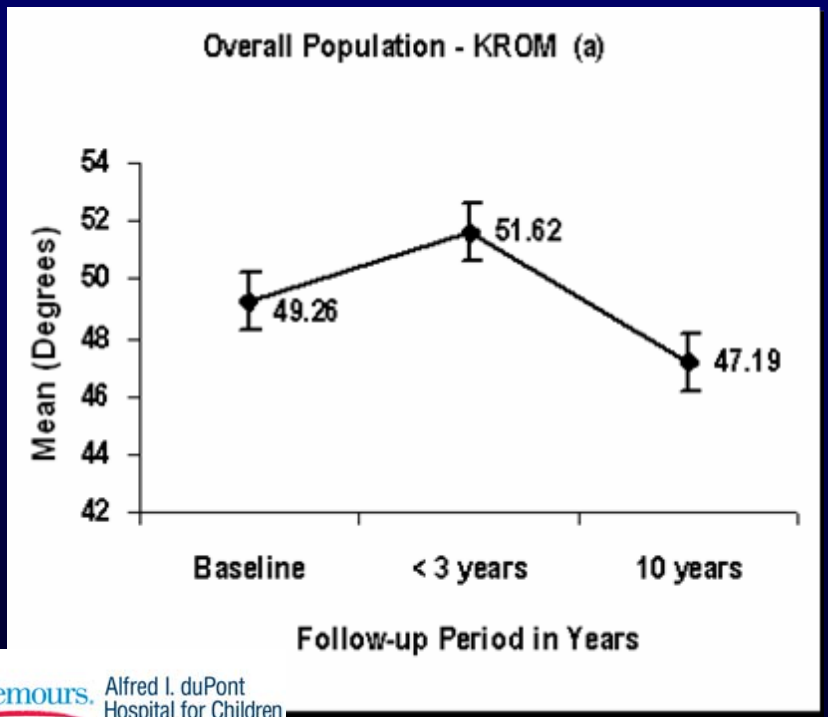


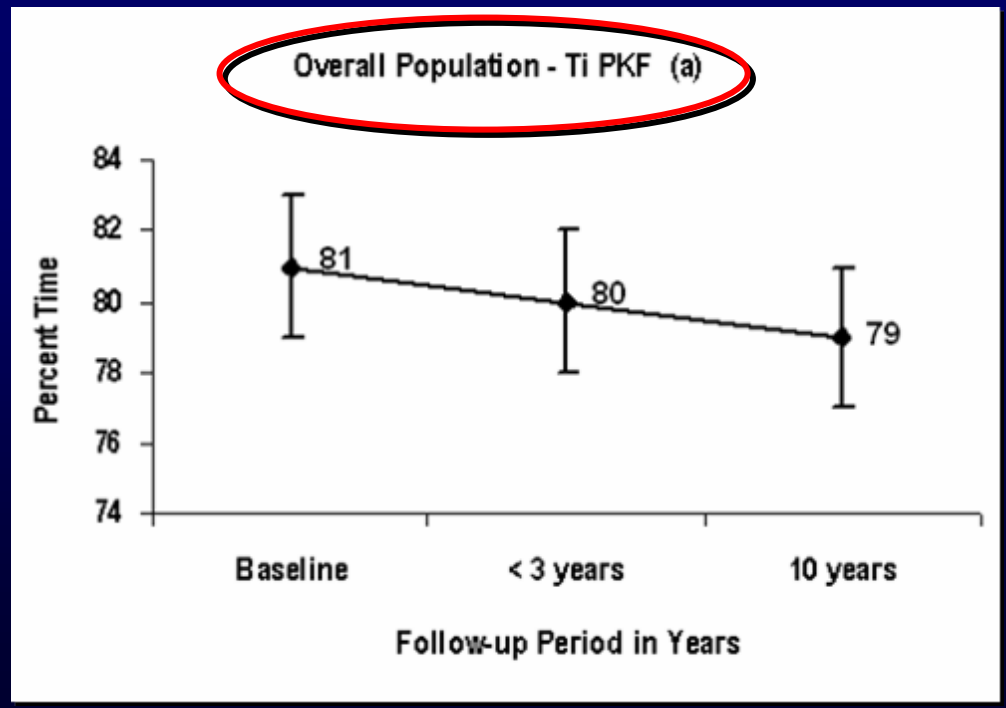


Results

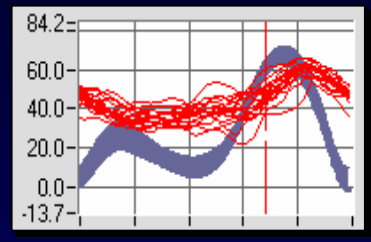
Population globale

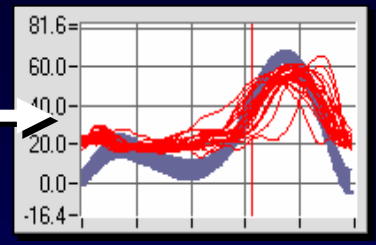






Conclusion





- *Population globale*:

  Bons résultats à court et long terme

Recommandations

- *Sous-groupes*:

  - Groupe à **PKF bas** & modéré — **PKF < 64º**
  - Groupe à **KROM bas** & modéré — **KROM < 53º**
  - Groupe à **TiPKF** tardif & modéré — **TiPKF > 80%**

10-Year Follow-Up Outcome of Rectus Femoris Transfer in Children with Spastic Cerebral Palsy Treated for Stiff Knee Gait
Thawrani D, Haumont T, Church C, Holmes L Jr, Dabney K, Miller F
(Soumis JBJS A sept 2009)

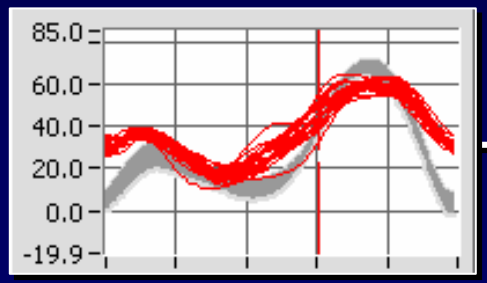
Question

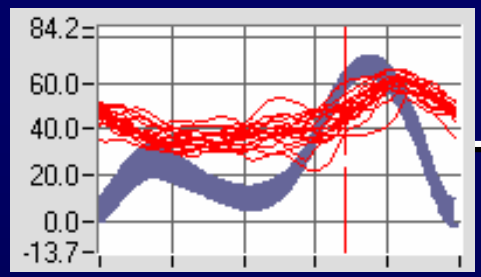
PA ?

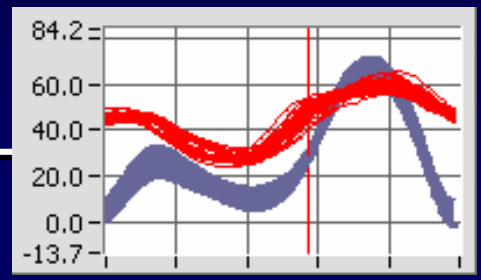
GMFM?

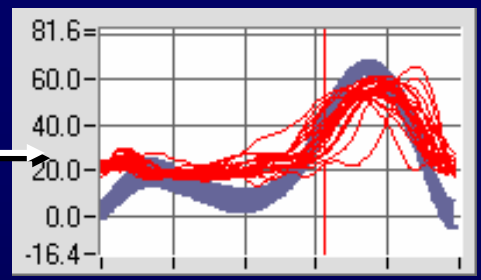
GV ?

VKF ?









Court-terme

Long terme

Y-a-t-il des prédicteurs des bons résultats du transfert du RF ?

Background & significance

Kinematic and kinetic factors that correlate with improved knee flexion following treatme ait.
Goldberg SR, Ounpuu S, Arnold AS, Gage JR, Delp SL.
J Biomech 2006;39(4):689-98

40 patients (18 limbs SKG)
Short-term FU (?)
PKF, KROM, ROMS, TiPKF
Low KV Toe Off – High KE Mo St

Predicting outcomes of rectus femoris transfer surgery.
Reinbolt JA, Fox MD, Schwartz MH, Delp SL.
Gait Posture. 2009 Jul;30(1):100-5

62 patients (5O patients)
Short-term FU (?)
HPo, Kpo, VKF TO: 80%
HIF, HiIR: 88%

Résultats

Table II: Combined Predictors of Short-term and Long-term Outcomes of Rectus Femoris Transfer in CP Children with Stiff Knee Gait using multivariable linear regression model.

Predictors	Short-term			Long-term		
	β Coef.	t-Value	*p*-Value	β Coef.	t-Value	*p*-Value
Peak Knee Flexion (PKF)*						
GV	0.12	2.53	0.01	0.12	2.24	0.03
PA	-0.31	-3.65	<0.001	-0.25	-2.75	0.01
*Adjusted for VKF **F = 7.31 *** R^2 = 0.13				*Adjusted for VKF **F = 4.88 *** R^2 = 0.12		
Knee Range of Motion (KROM)						
GMFM	0.19	2.12	0.04	0.23	2.54	0.01
VKF	-	-	-	-0.03	-2.10	0.04
F = 4.51 * R^2 = 0.04				**F = 4.16 *** R^2 = 0.10		
Time to Peak Knee Flexion (TiPKF)						
GV	0.05	2.68	0.009	0.05	2.51	0.01
VKF	-	-	-	-0.01	-2.22	0.03
*Adjusted for VKF **F = 4.02 *** R^2 = 0.04				**F =3.95 *** R^2 = 0.04		
Toe Drag						
GV	-	-	-	-0.01	-3.46	0.001
PA	-0.01	-2.22	0.03	-	-	-
*Adjusted for GMFM & GV **F = 7.10 *** R^2 = 0.19				**F = 11.99 *** R^2 = 0.12		

Recommandations

Short	PKF	KROM	TiPKF	TD	***Long***	PKF	KROM	TiPKF	TD
PA	50º			52º		50º			
GMFM		57%					57%		
GV	68		68			68		68	77
VKF							57		

Outcome Predictors of rectus femoris transfer s in cerebral palsy children with stiff knee gait
Haumont T, Thawrani D, Church C, Holmes L Jr, Niiler T, Dabney K, Miller F
(A soumettre JBJS-B Octobre 2009)

Traitement chirurgical des membres inférieurs

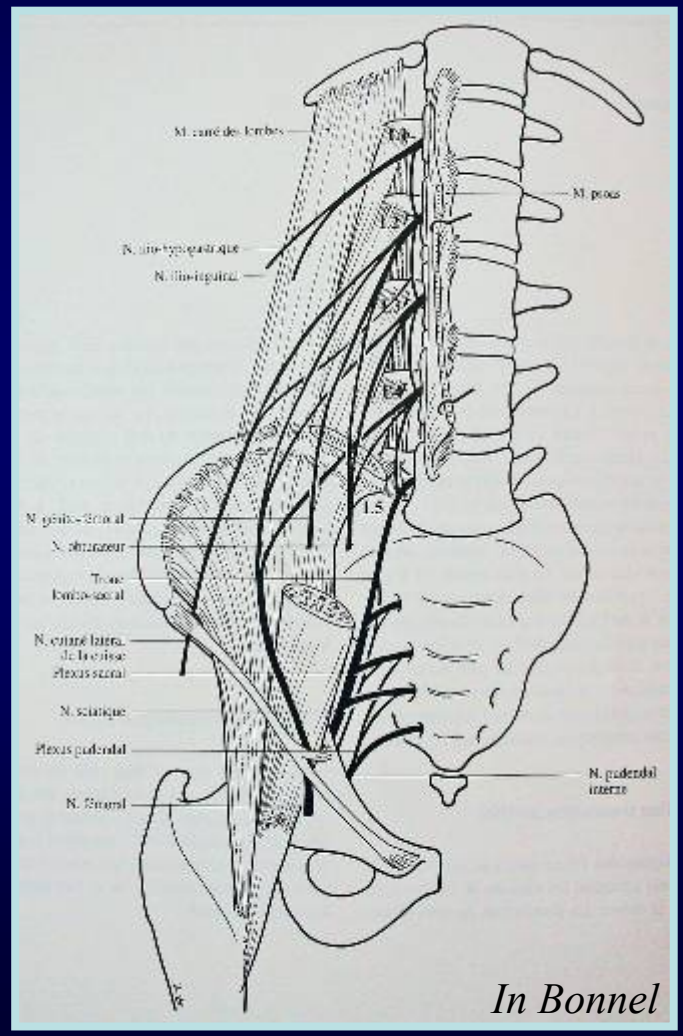
Rétractions

<u>Ténotomie</u> peut être utilisée pour :

- *Droit fémoral*
- Psoas

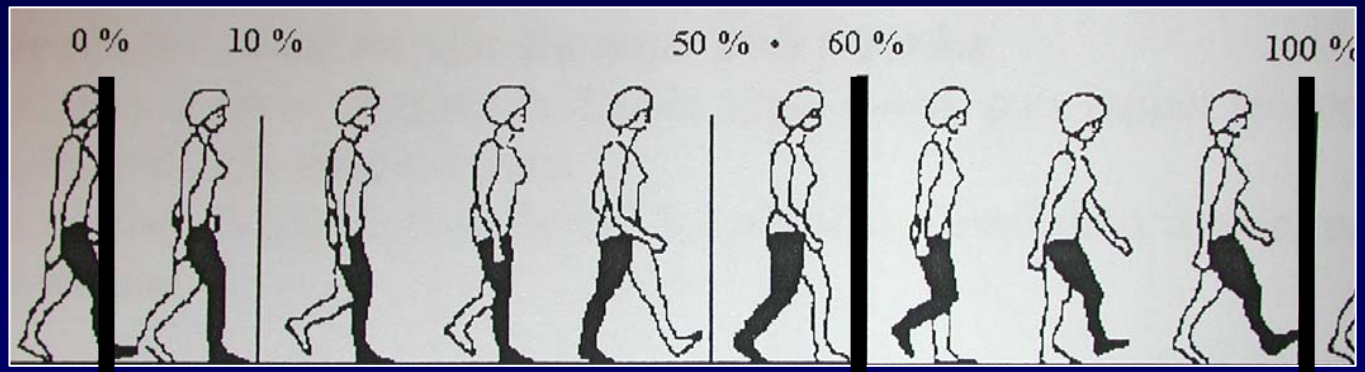
Traitement chirurgical des membres inférieurs

Rétractions



Rétraction Psoas

Hanche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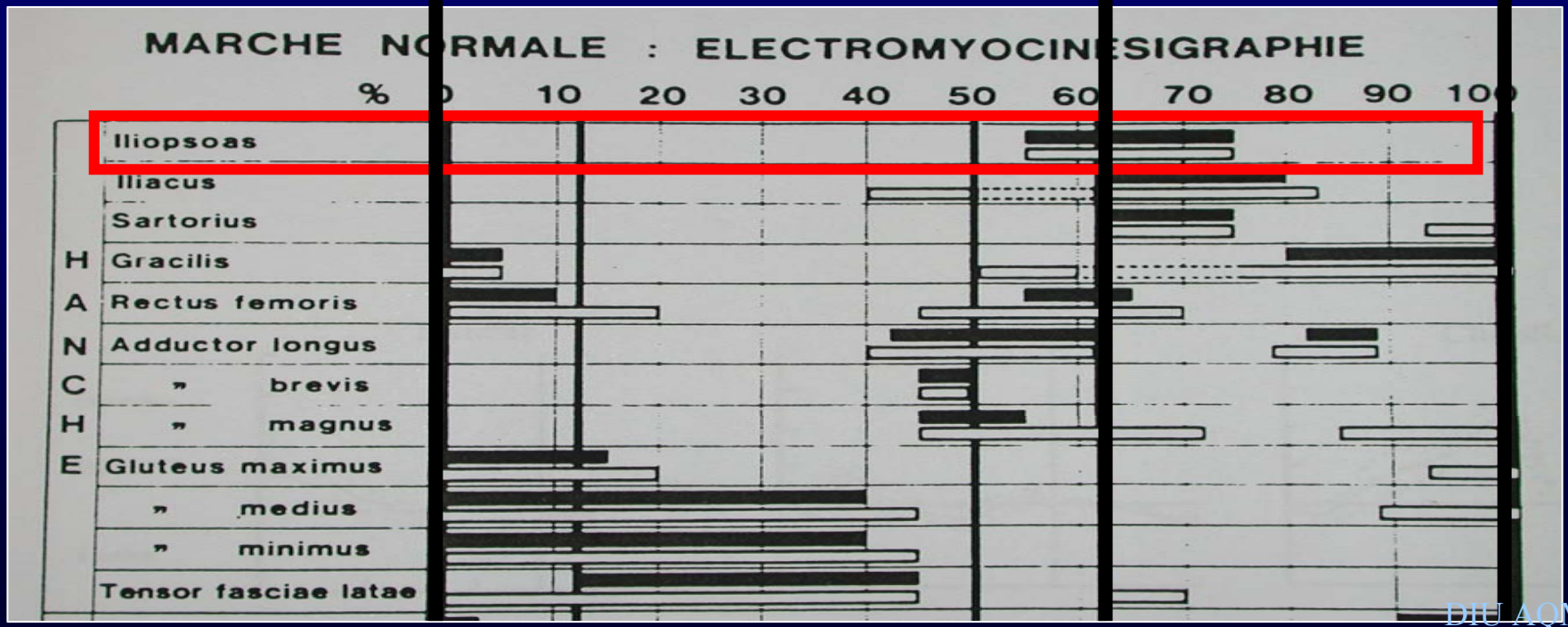
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Iliopsoas
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Sartorius
Gracilis
Rectus femoris
Adductor longus
" brevis
" magnus
Gluteus maximus
" medius
" minimus
Tensor fasciae latae

Traitement chirurgical des membres inférieurs

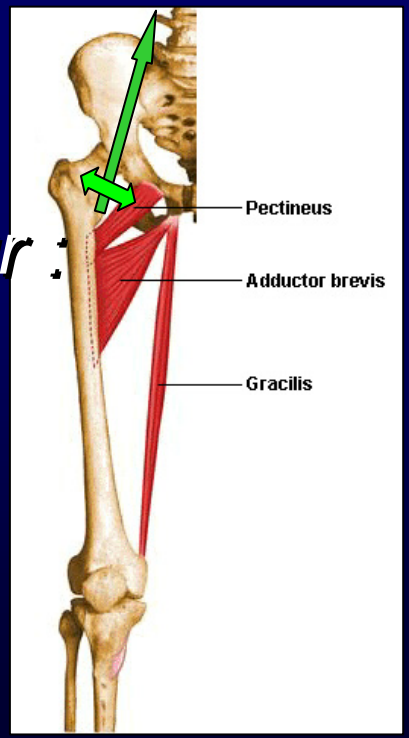
Rétractions: Allongement - Ténotomie

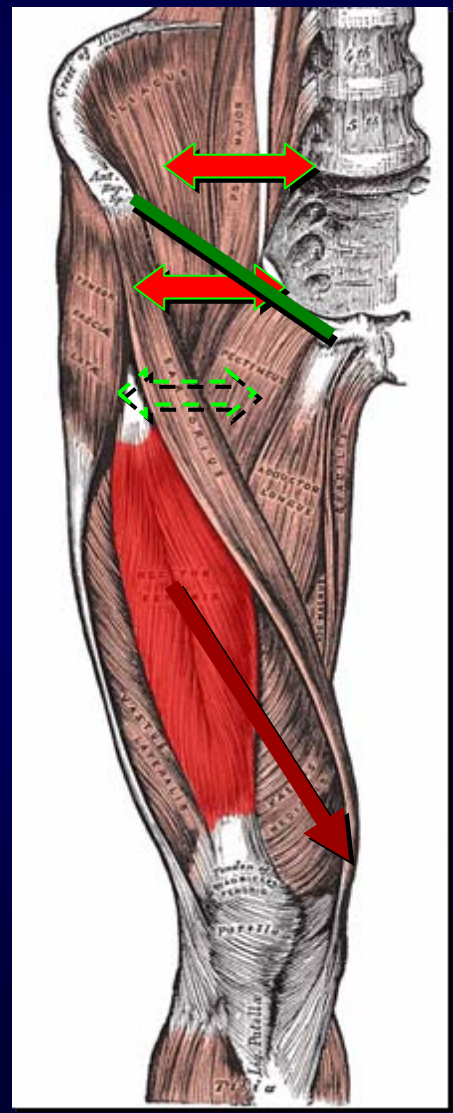
<u>Ténotomie</u> peut être utilisée pour :

- *grabataire +*

<u>Allongement</u> à utiliser pour :

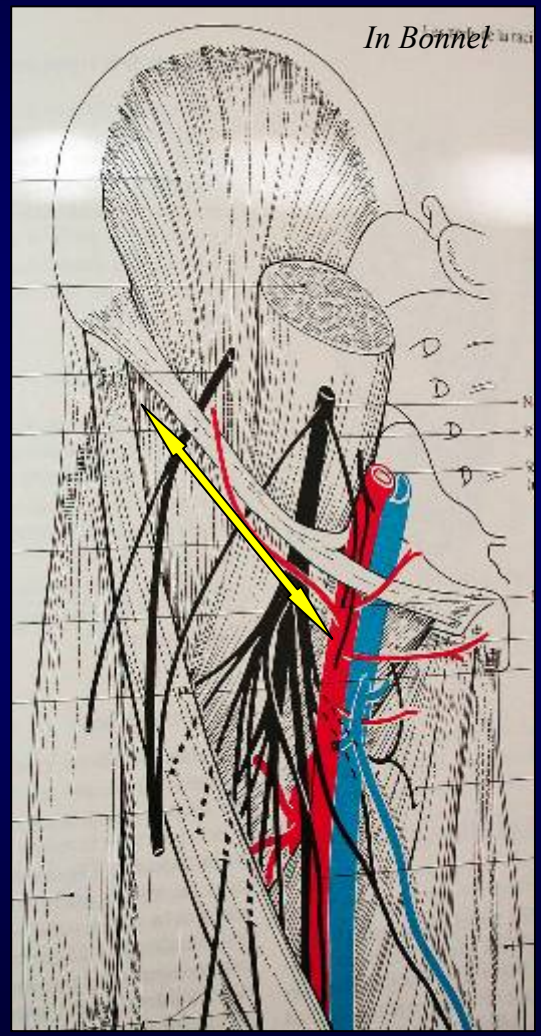
- *l'enfant marchant*





Traitement chirurgical des membres inférieurs

Rétractions

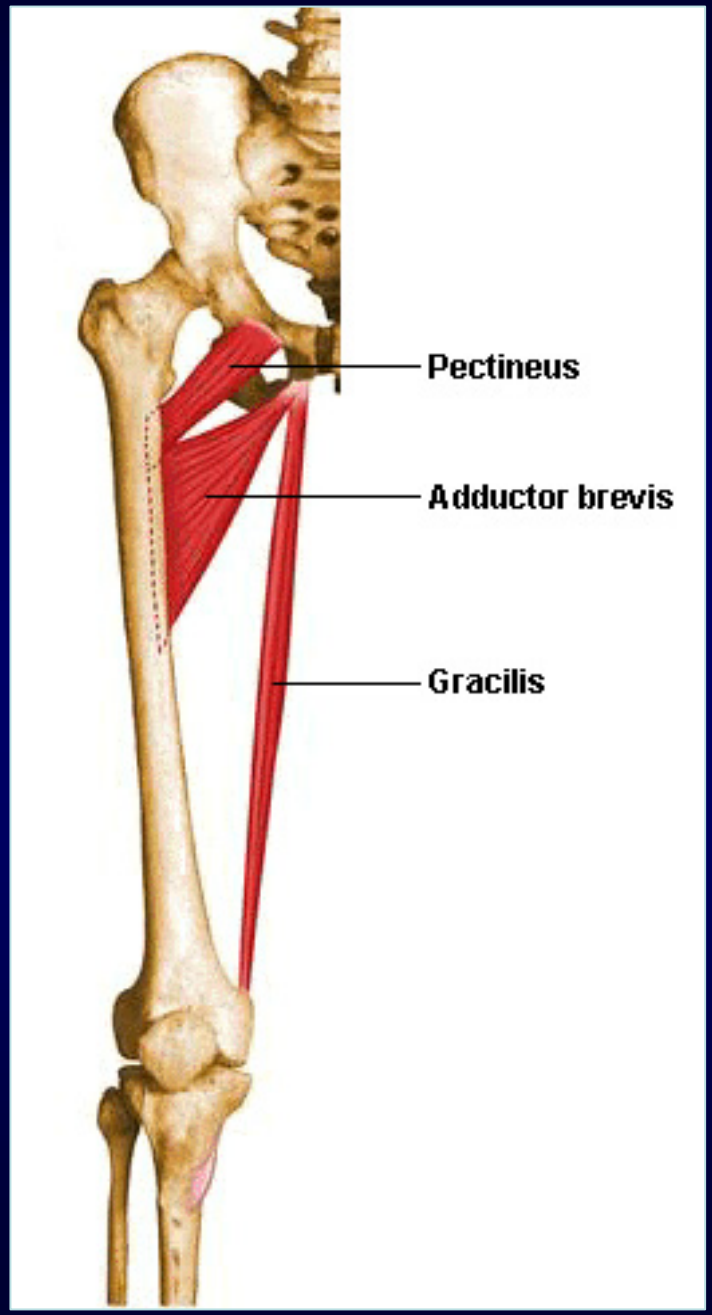


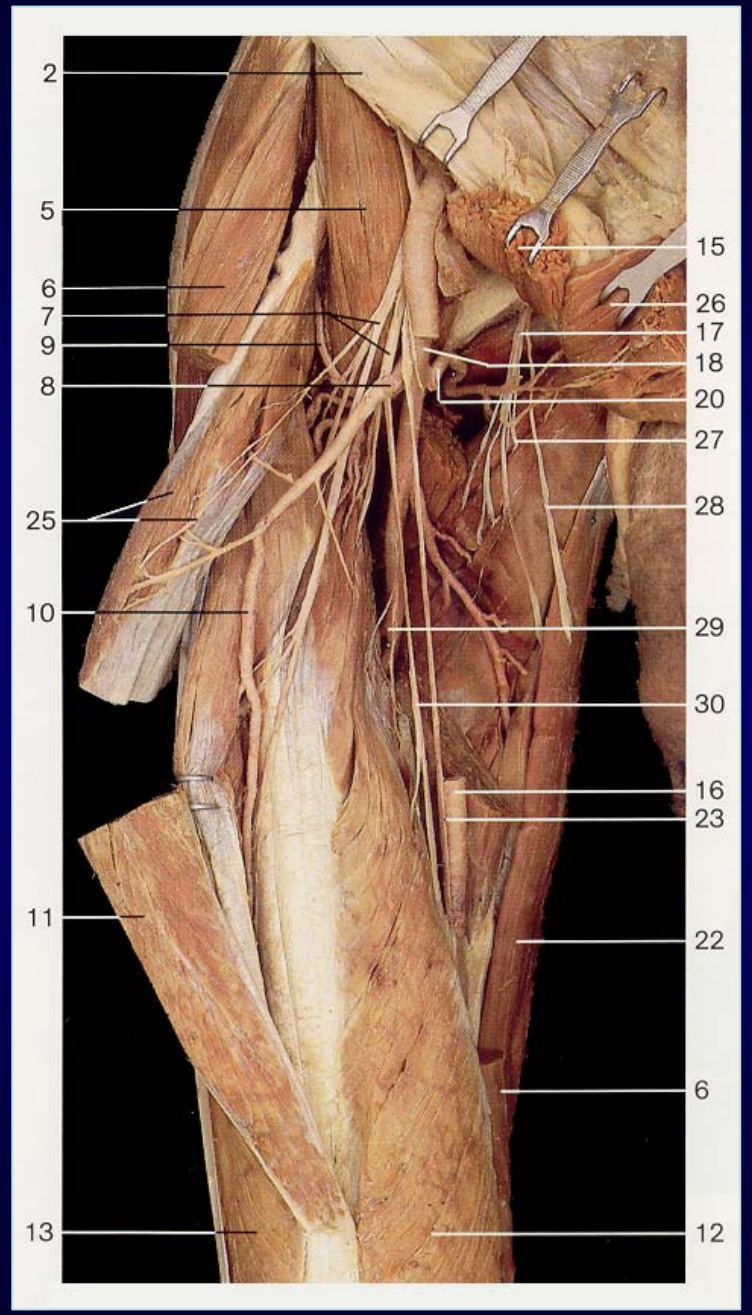
Traitement chirurgical des membres inférieurs

Rétractions

<u>Ténotomie</u> peut être utilisée pour :

- Droit fémoral
- Psoas
- *Adducteurs*


Pectineus
Adductor brevis
Gracilis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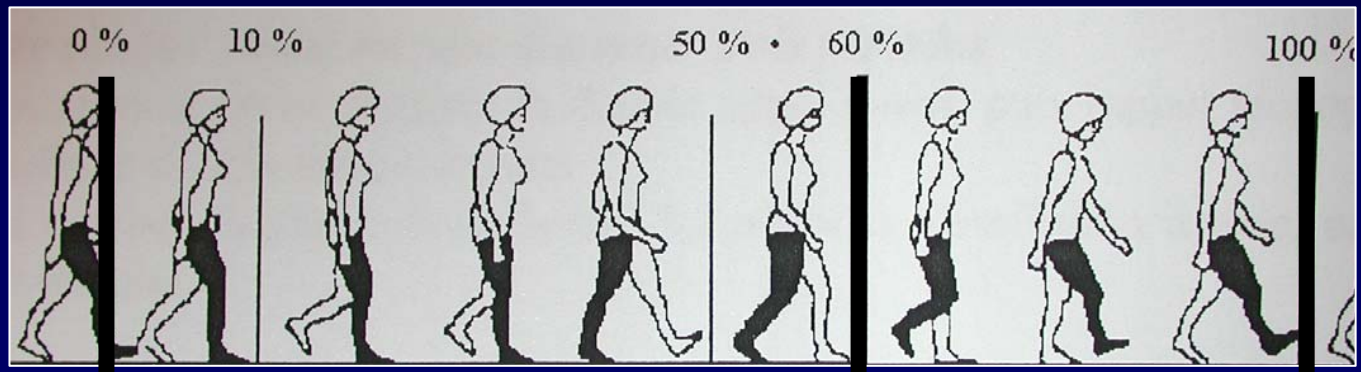
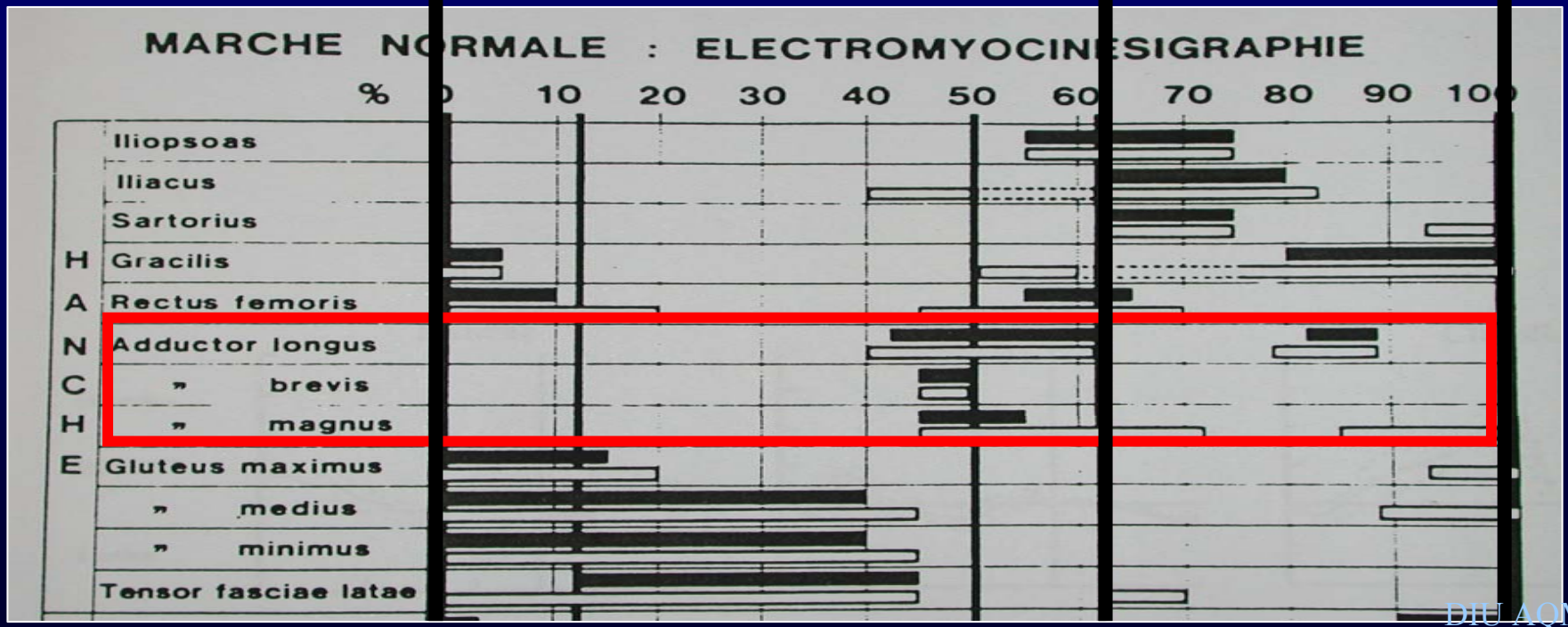
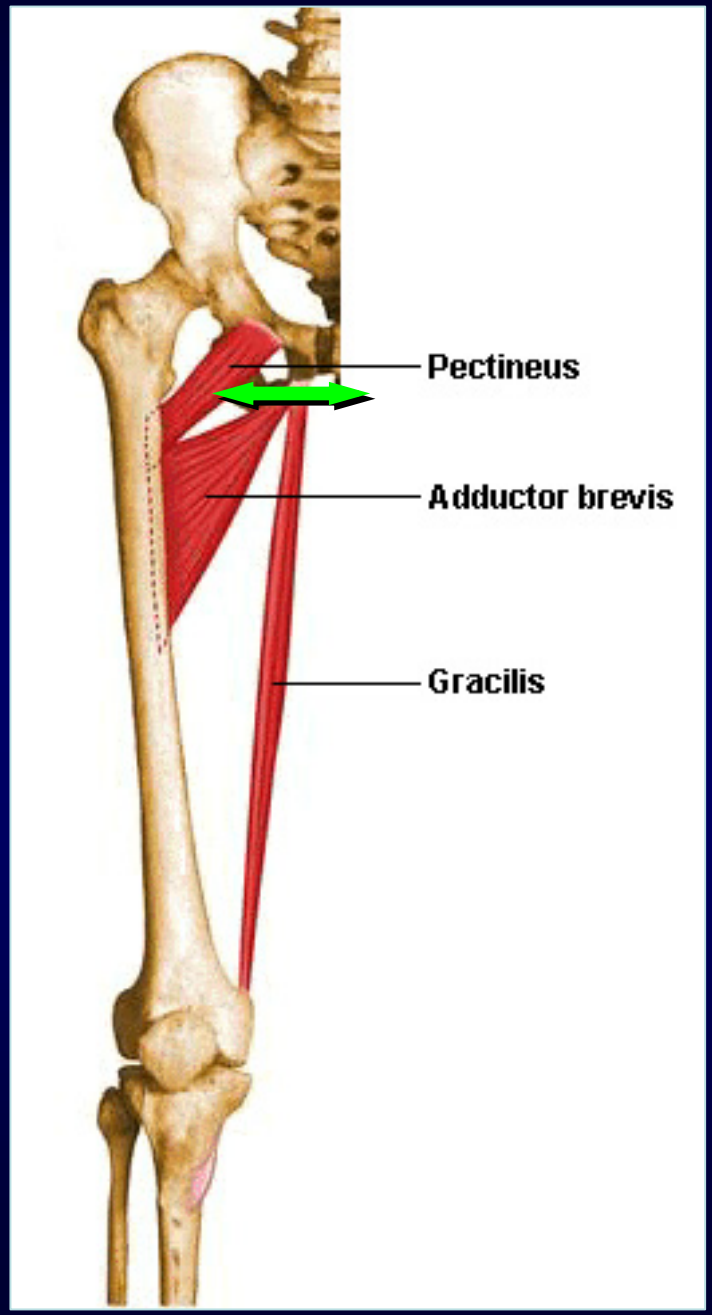
Hanche - Long adducteur

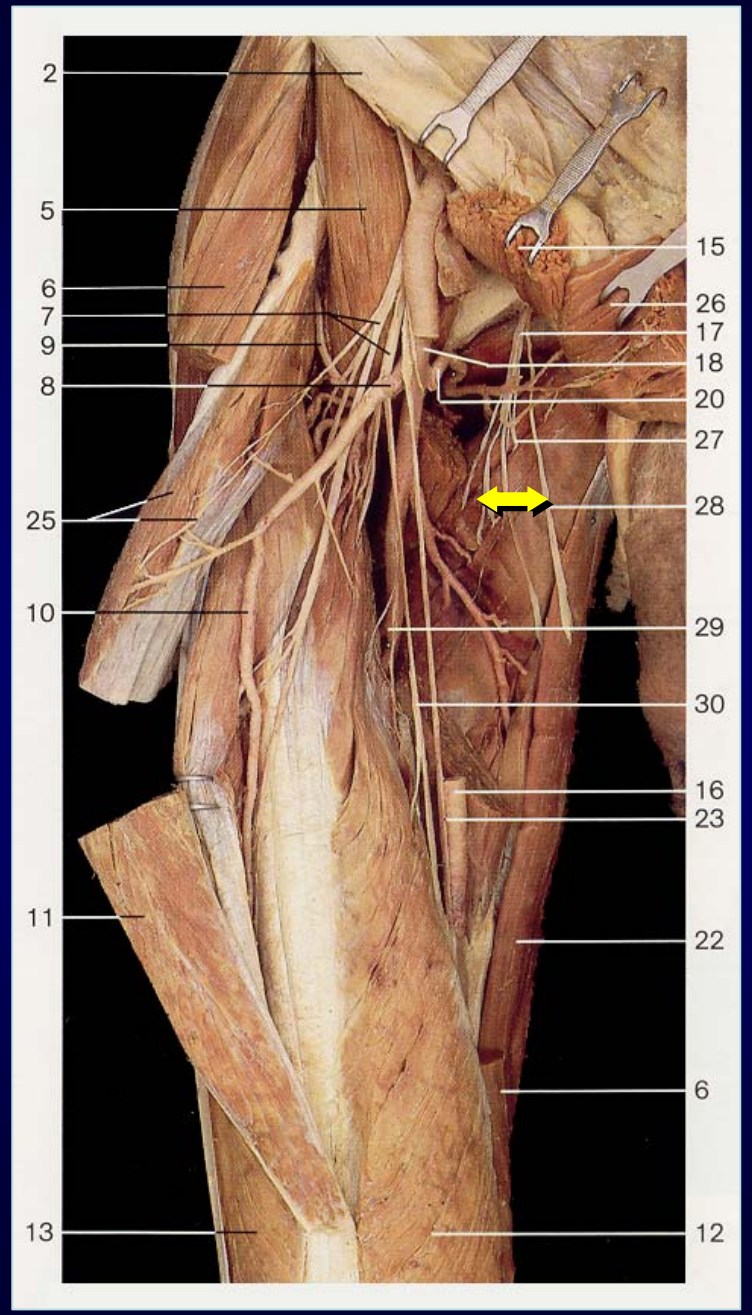
Hanche – Rotation interne

Hanche - Adducteurs






Pectineus
Adductor brevis
Gracilis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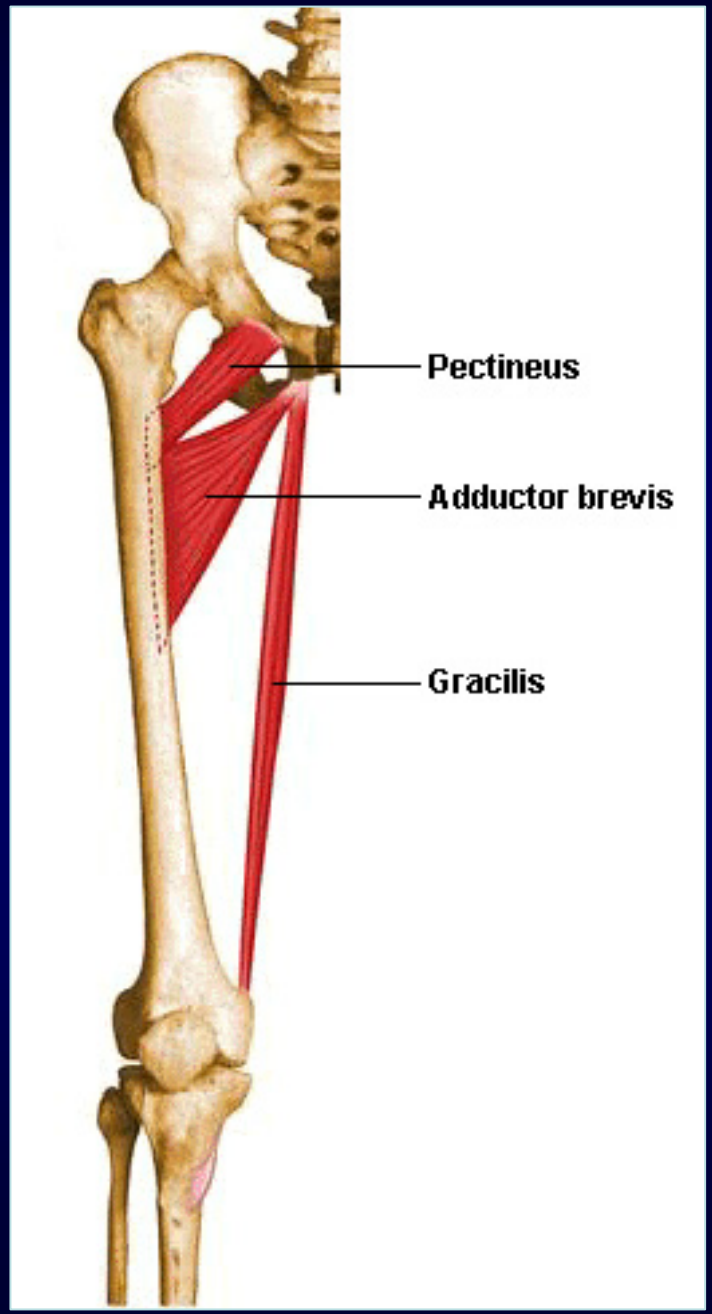
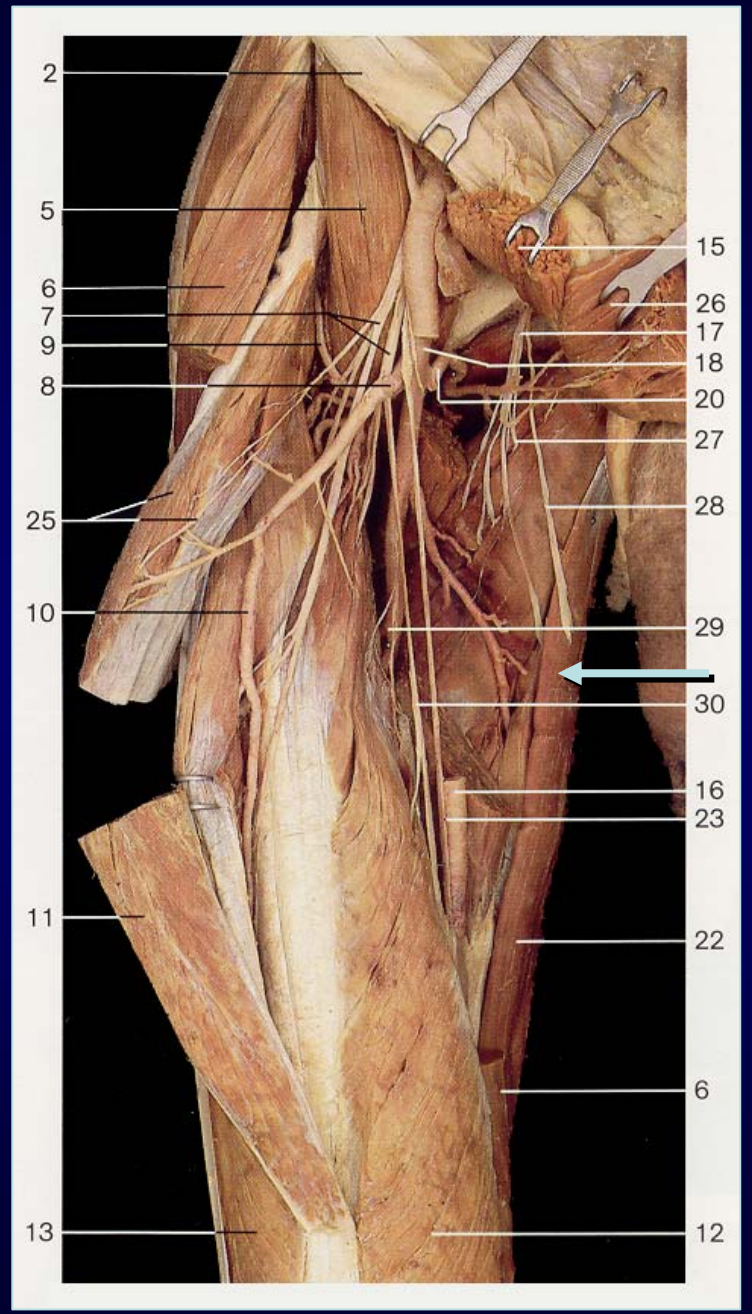
Traitement chirurgical des membres inférieurs

Rétractions: Ténotomie

<u>Ténotomie</u> peut être utilisée pour :

- Droit fémoral
- Psoas
- *Adducteurs*
- *Gracile*


Pectineus
Adductor brevis
Gracilis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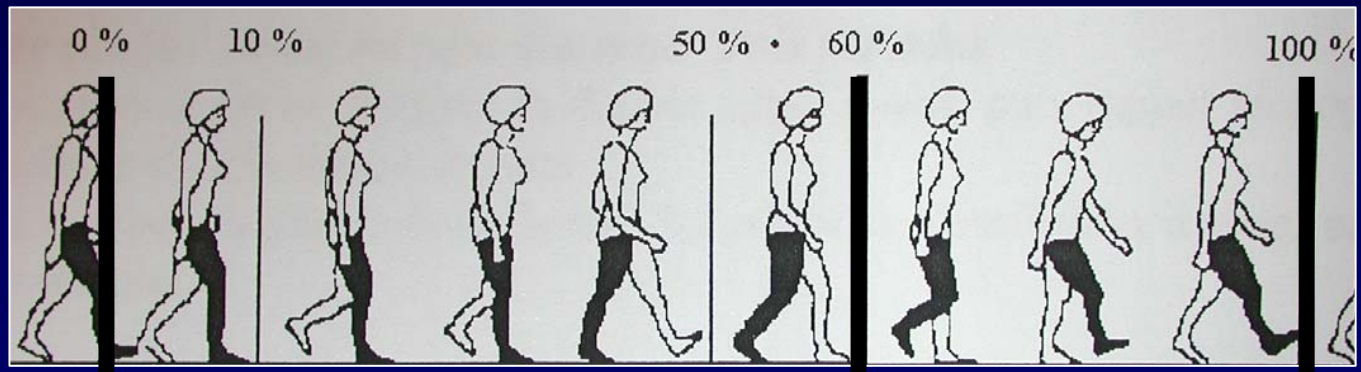
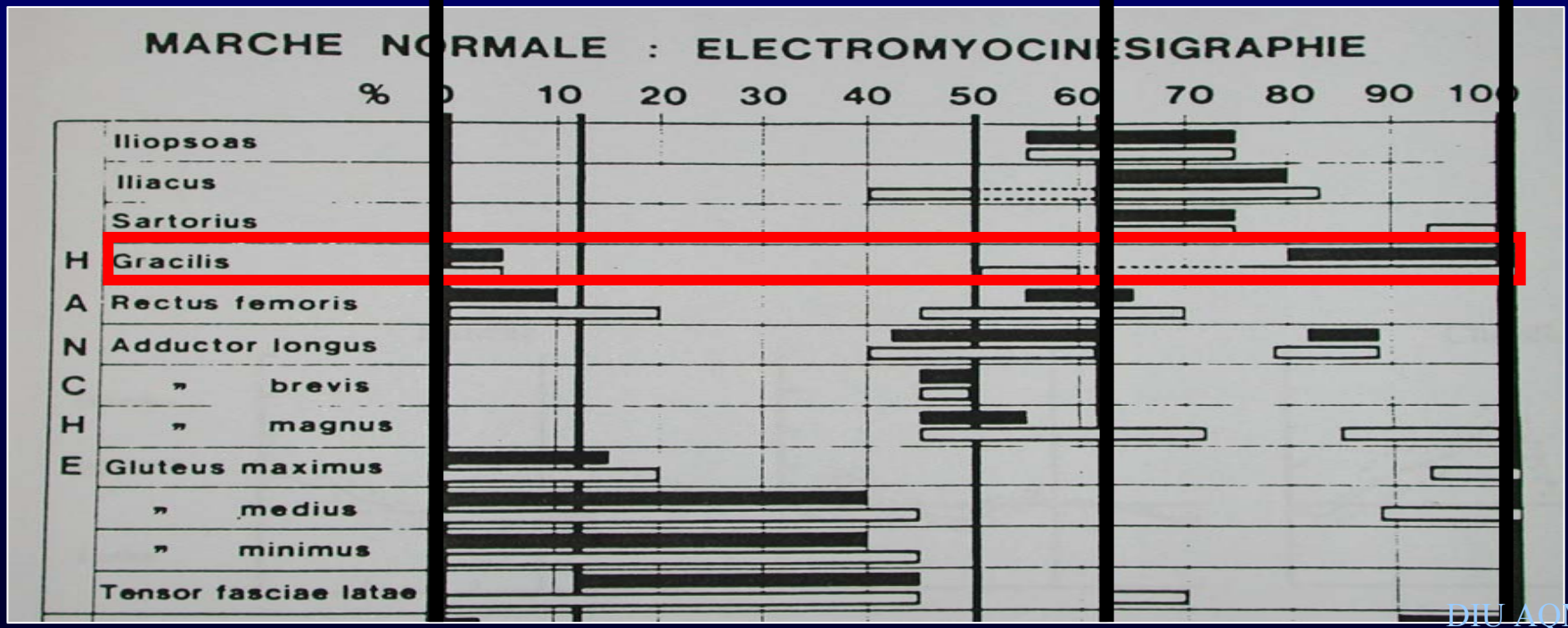
Hanche - Gracile

Hanche - Gracile





Traitement chirurgical des membres inférieurs

Rétractions: Ténotomie

Attention: le muscle n'est pas une « ficelle rétractile »

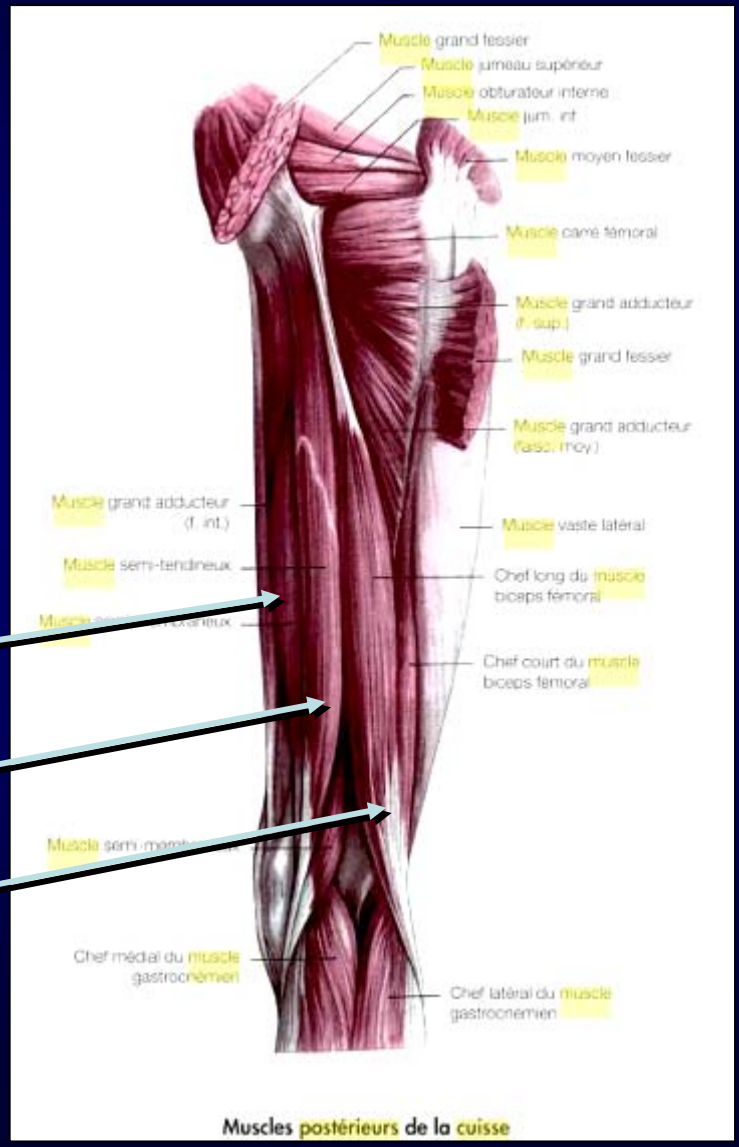
- Un muscle présente des adhérences sur son trajet.
- Une ténotomie proximale ou distale peut avoir des conséquences quelque peu variable sur un muscle biarticulaire en particulier.

Traitement chirurgical des membres inférieurs

Rétractions

Ischio-jambiers

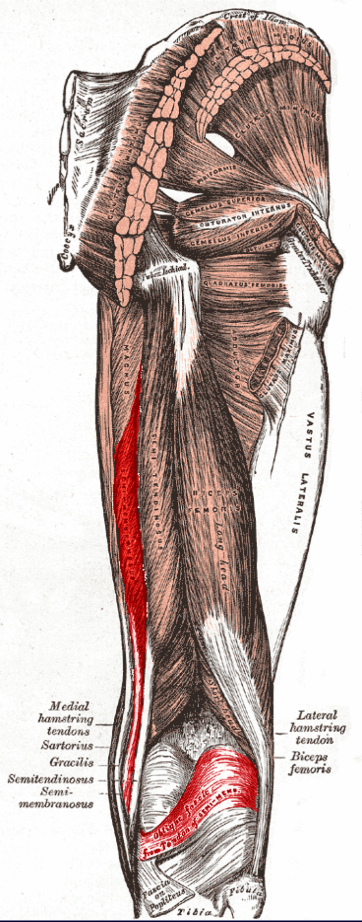
- *Semi-Membraneux*
- *Semi-Tendineux*
- *Biceps*

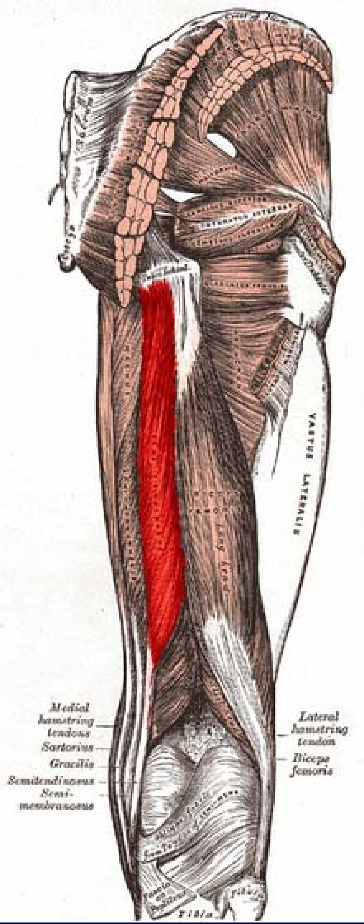


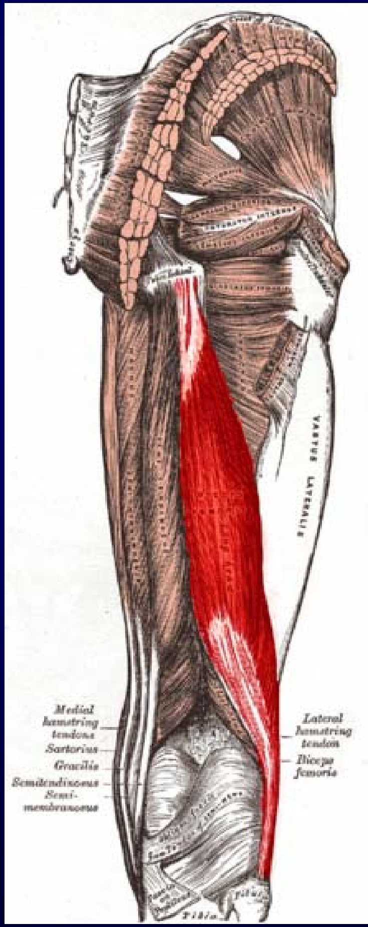
Muscles postérieurs de la cuisse

Traitement chirurgical des membres inférieurs

Rétractions Ischio-jambiers





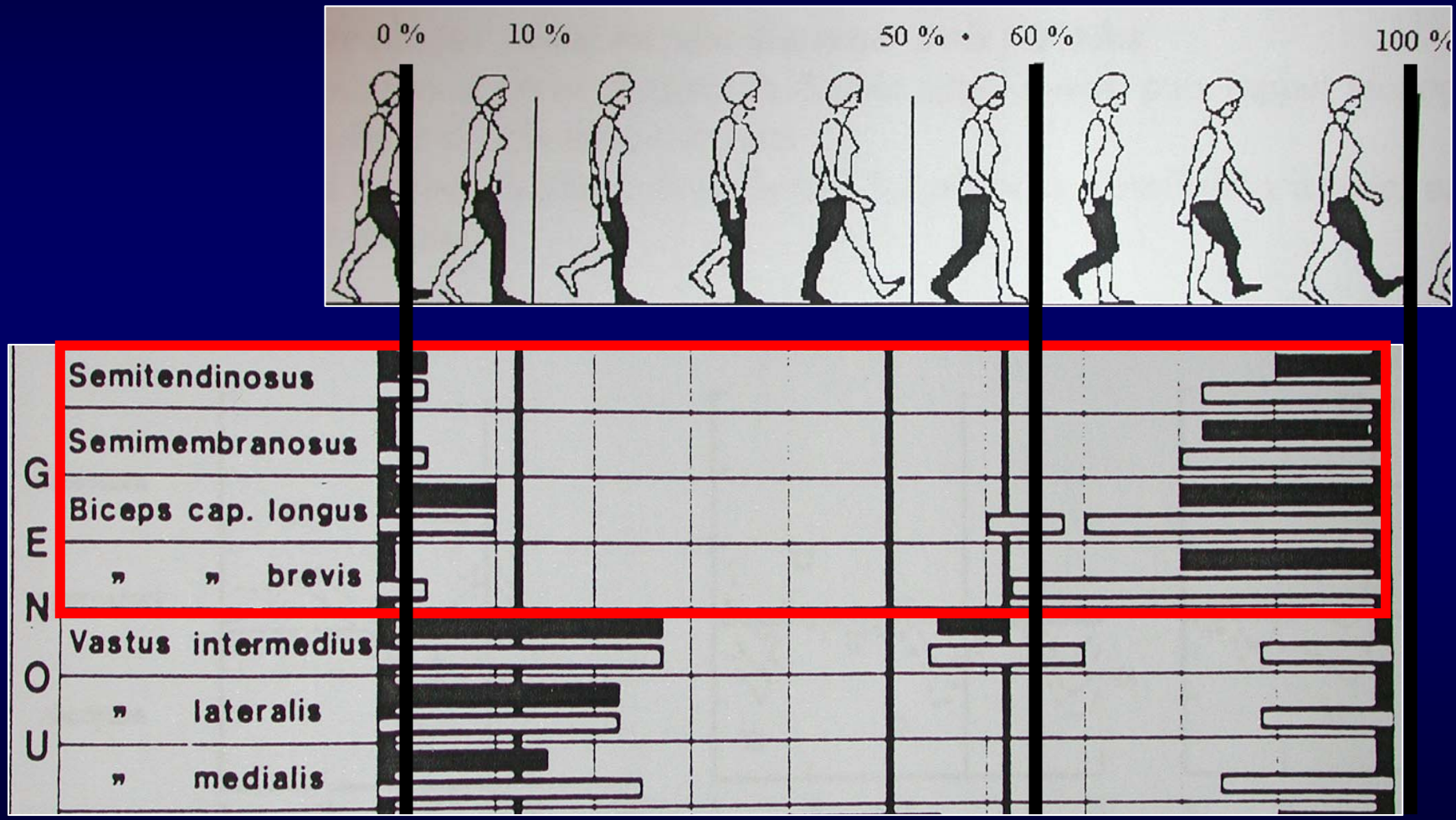


Traitement chirurgical des membres inférieurs

Rétractions Ischio-jambiers

Angle Poplité

Genou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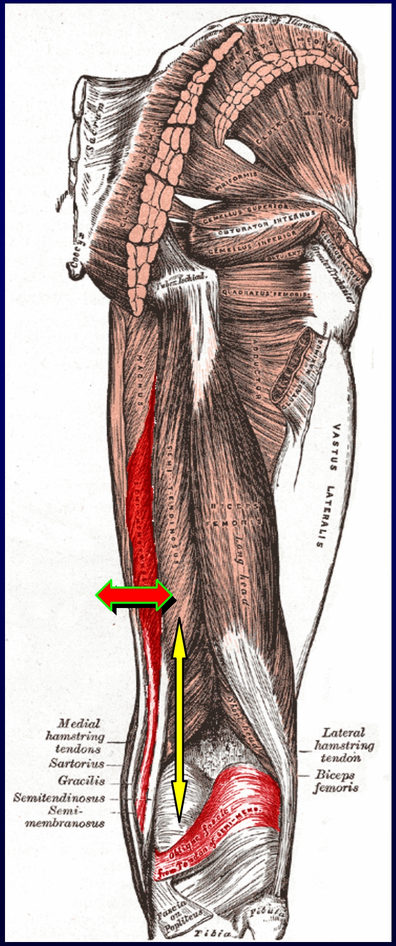
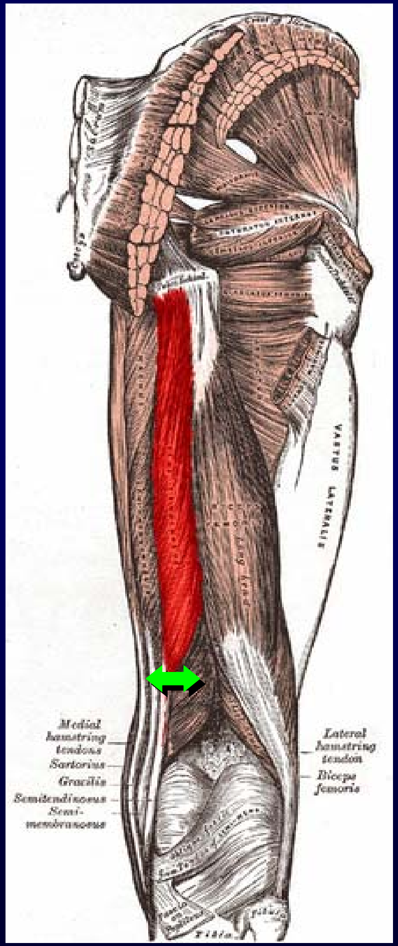
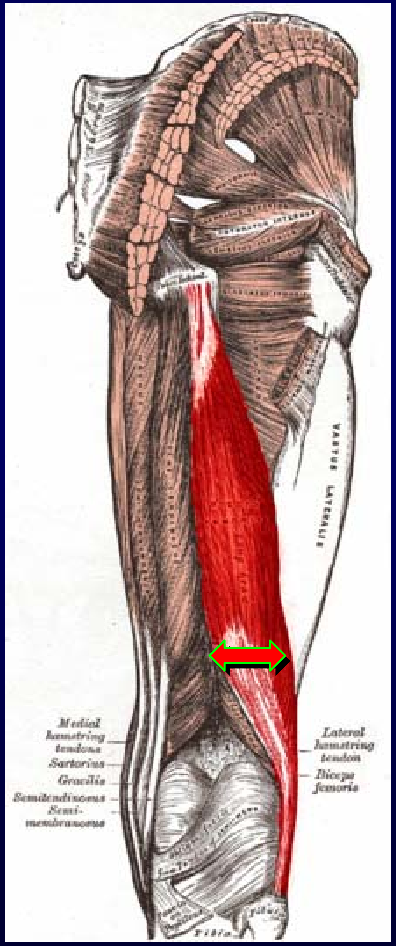
GENOU
Semitendinosus
Semimembranosus
Biceps cap. longus
" " brevis
Vastus intermedius
" lateralis
" medialis

Traitement chirurgical des membres inférieurs

Rétractions Ischio-jambiers





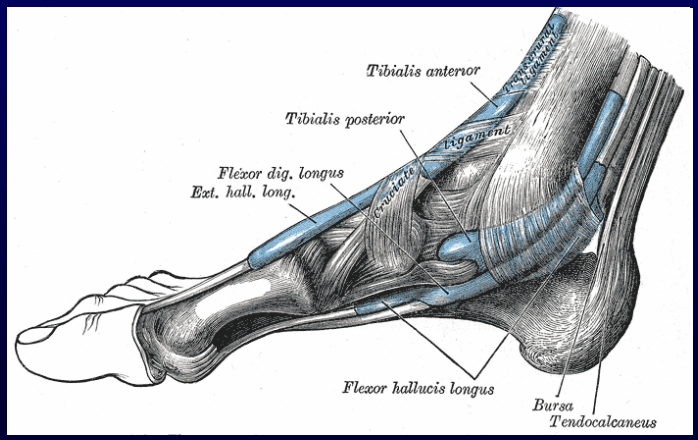


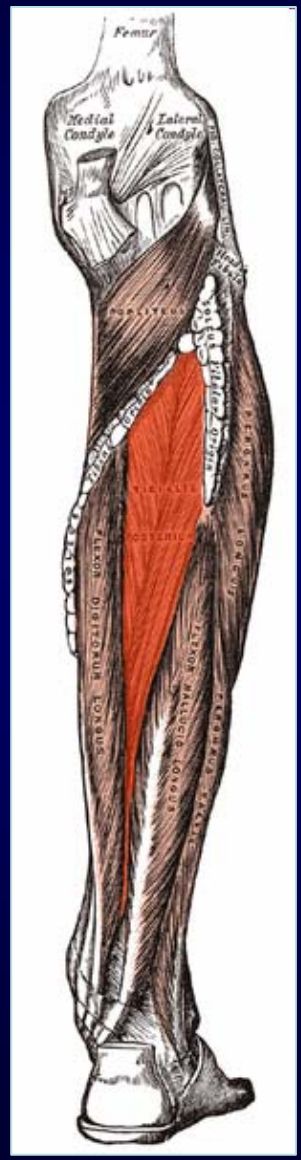
Traitement chirurgical des membres inférieurs

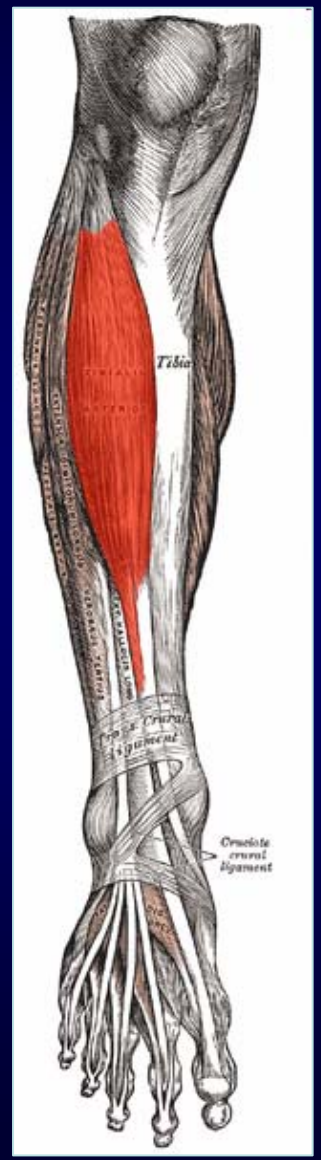
Rétractions

Tibial Antérieur

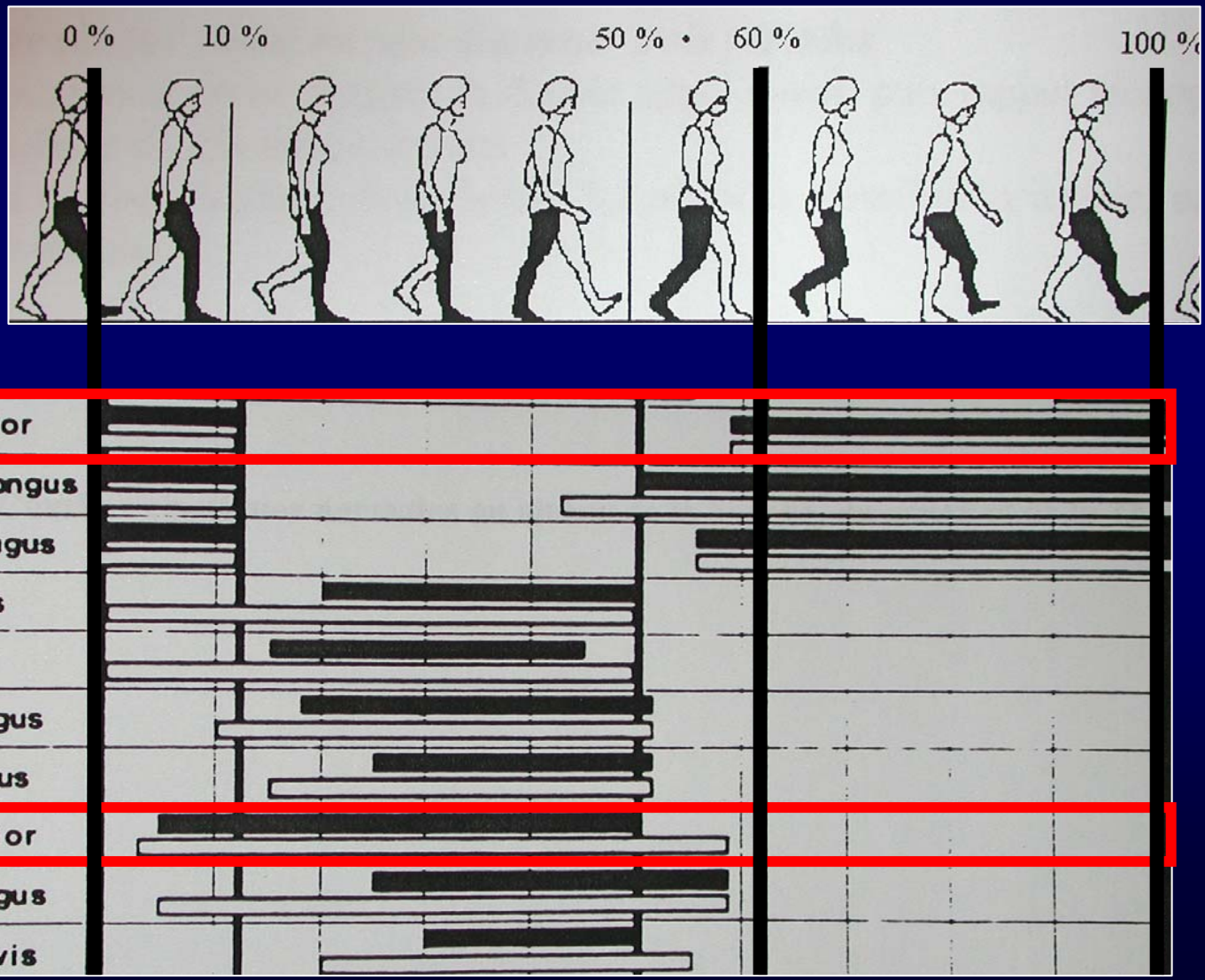
Tibial Postérieur







Cheville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Tibialis anterior
Extens. digit. longus
Extens. hall. longus
P Gastrocnemius
I Soleus
E Flexor digit. longus
D Flexor hall. longus
Tibialis posterior
Peroneus longus
„ brevis

Traitement chirurgical des membres inférieurs

Rétractions – Varus équin

- *Réductible*
- *Irréductible*

Traitement chirurgical des membres inférieurs

Rétractions – Varus équin

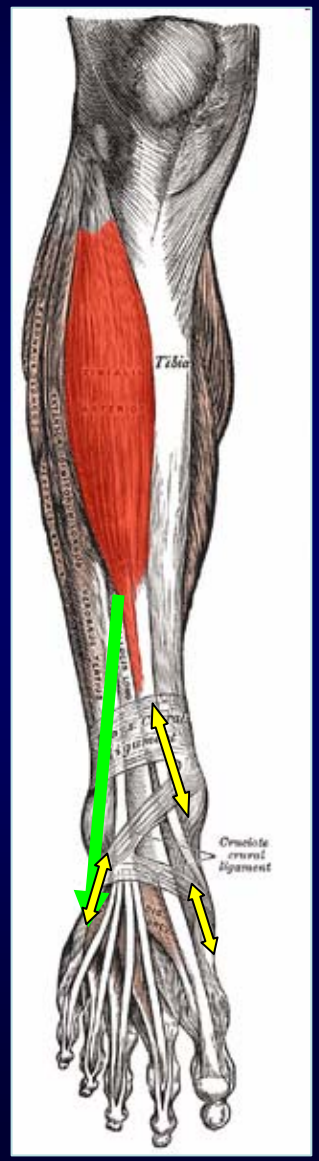
Tibial Antérieur

- *½ transfert TA*

Hémiplégique

Si TP pas trop spastique ni très rétracté ++

Ne marche pas bien chez le paraplégique



Traitement chirurgical des membres inférieurs

Rétractions – Varus équin

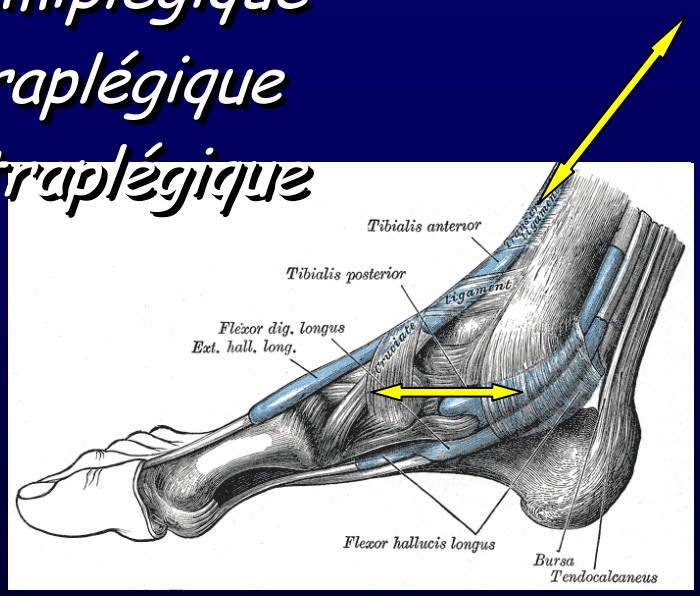
Tibial Postérieur

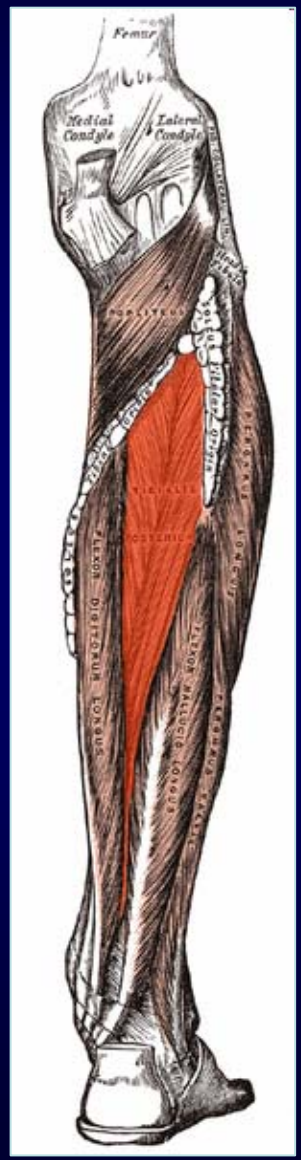
Si TP très spastique ou rétracté ++

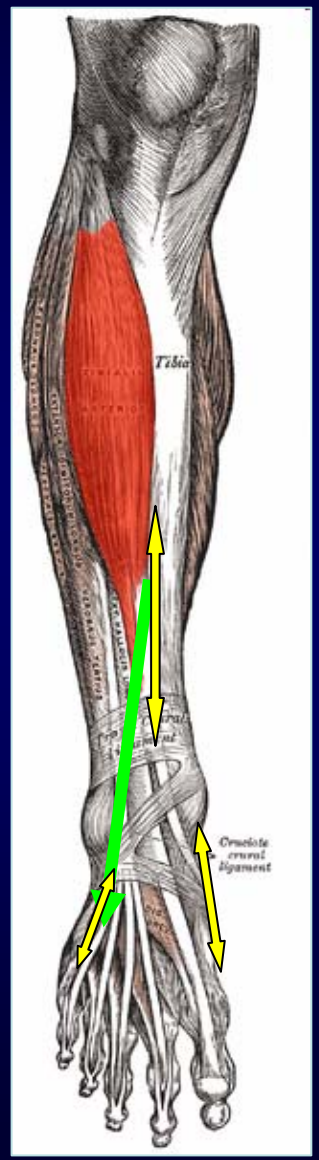
Hémiplégique

Paraplégique

Tétraplégique







Traitement chirurgical des membres inférieurs

Rétractions – Varus équin

ORIGINAL ARTICLE

Effect of Attachment Site and Routing Variations in Split Tendon Transfer of Tibialis Posterior

Matthew F. Moran, MS,† James O. Sanders, MD,‡ Neil A. Sharkey, PhD,*†§¶ and Stephen J. Piazza, PhD*†‖§¶*

Abstract: Spastic equinovarus is a condition that commonly affects the gait of children with cerebral palsy. Split tendon transfers of the tibialis posterior (TP) are often performed to eliminate the excessive hindfoot inversion present in equinovarus. TP muscle moment arms were computed before and after three variations of split TP tendon transfer to assess the effectiveness of each. The three surgeries tested were (1) the original split TP transfer to the distal peroneus brevis tendon routing behind the lateral malleolus; (2) an attachment variation in which the transferred tendon half was attached to the proximal peroneus brevis tendon rather than to the distal site; and (3) a routing variation in which the transferred tendon half was passed through a window in the interosseous membrane and attached to the distal peroneus brevis tendon. Tendon tension was controlled for in these experiments because proper tendon energy is often cited as a reason for poor outcomes. All three surgeries significantly reduced the ability of TP to invert the hindfoot, thus eliminating a potential deforming force, but the reduction following interosseous routing was significantly less than that found for the other two transfer procedures. Routing through the interosseous membrane also reduced the ability of the TP to plantarflex the foot, but ankle actions were preserved following the other two surgeries. Routing through the interosseous membrane to an anterior attachment site resulted in a muscle with minimal potential to create or resist action about the ankle joint. Similar moment arms were measured when the attachment site on the peroneus brevis tendon was located either proximally or distally, suggesting that this choice does not appear to significantly affect the mechanical outcome.

Key Words: split tendon transfer, equinovarus, tibialis posterior, moment arms

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Study conducted at the Pennsylvania State University, University Park, Pennsylvania.

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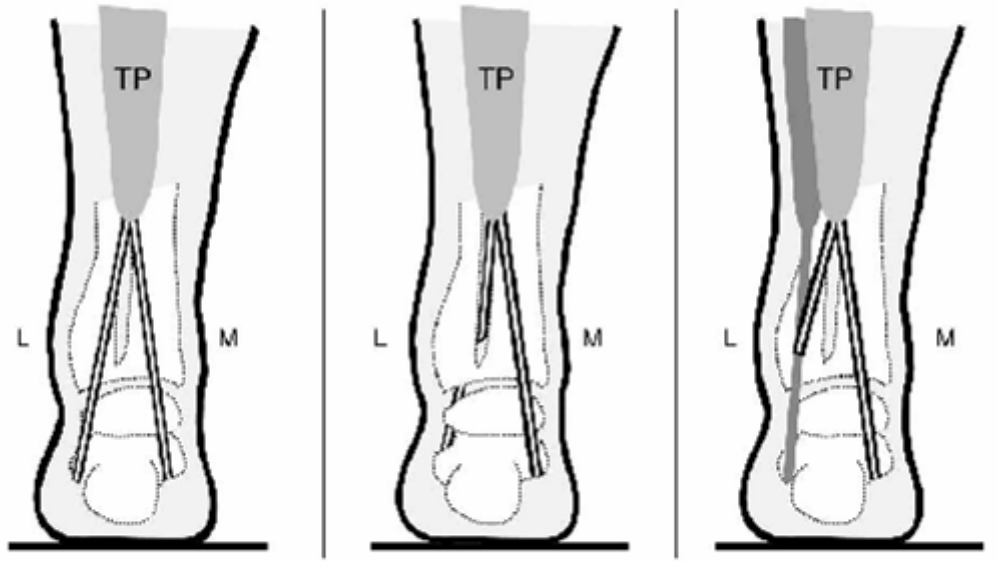
Hindfoot varus is a musculoskeletal deformity in which the calcaneus is excessively inverted relative to the talus. This deformity is commonly accompanied by equinus and often affects children with cerebral palsy. Without proper intervention this foot disorder may lead to bony deformities that impede gait and diminish quality of life.[1,2] When the tibialis posterior (TP) can be identified as the primary deforming force, then a split tendon transfer of the TP (SPOTT) has been recommended as a possible surgical solution.[3–5,11,12,7,14]

The original SPOTT procedure, as described by Kaufer,[7] involves longitudinally splitting the distal TP tendon and detaching half of it from its navicular insertion site. The detached tendon half is routed behind the lateral malleolus and reattached to the distal peroneus brevis tendon (Fig. 1A). The primary goals of the surgery are to retain the TP as a plantarflexor, eliminate varus positioning of the heel, and retain a medial attachment site to aid in support of the talonavicular joint. Variations to the original SPOTT procedure have included alternative attachment sites[12] and routing of the split-transferred TP tendon.[11,14] Most outcome studies have reported good results for the SPOTT procedures, but it may be difficult to isolate the effects of variations in SPOTT from concomitant Achilles tendon lengthening.[4]

Medina et al[12] attached the split tendon half to the proximal peroneus brevis tendon rather than the distal peroneus brevis tendon attachment site (see Fig. 1C). This variation reduced the complexity of surgery and eliminated the need for a lateral dissection on the dorsum of the foot. Both Mulier et al[13] and Saji et al[14] described procedures in which the split-transferred TP tendon was routed through the interosseous membrane to the dorsum of the foot. Saji et al[14] attached the split TP tendon half to the lateral cuneiform, while Mulier et al[13] attached it to the distal peroneus brevis tendon (see Fig. 1B). Both sets of authors recommended this surgery for patients exhibiting TP overactivity and dorsiflexor weakness. They hypothesized that transferring through the interosseous membrane would correct the varus positioning of the heel and also rectify the accompanying equinus condition by restoring active dorsiflexion strength with an anterior attachment site of the split-transferred TP tendon half.



Traitement chirurgical des membres inférieurs

Rétractions

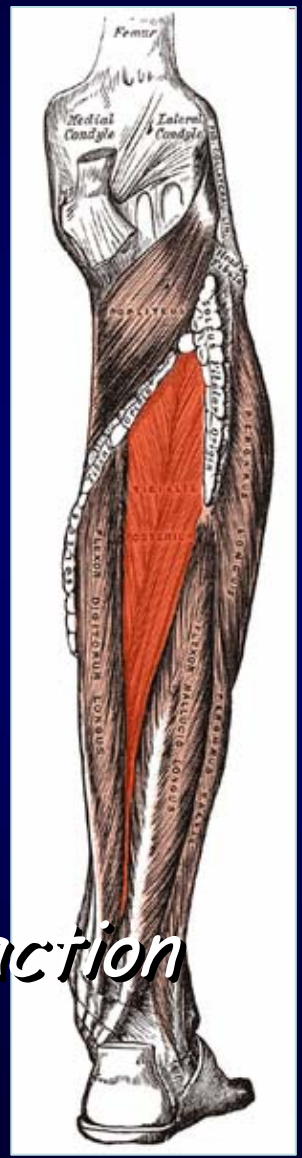
TP/TA

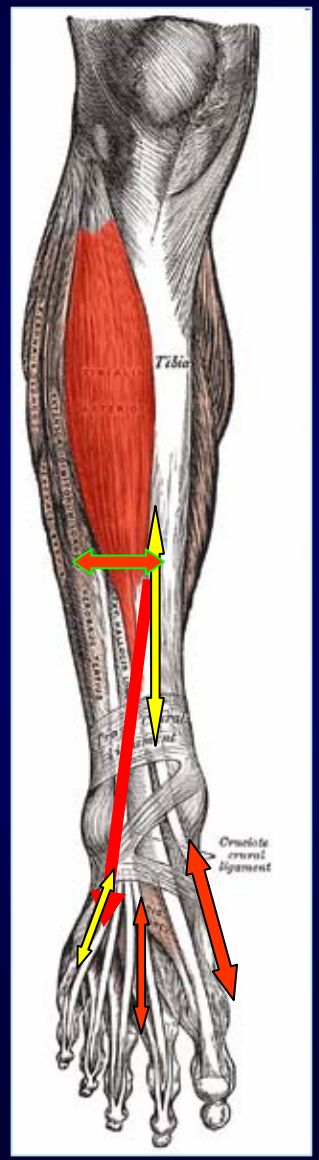
Hémiplégique

Paraplégique

Tétraplégique

- *Pas d'activité TA*
- *Génère pied plat*
- *Remarquable satisfaction*





Toméno RCO

Traitement chirurgical des membres inférieurs

Déformation structurale: Ostéotomie

Ostéotomie est utilisée pour :

Y. Blanc

*R*estituer une structure osseuse adaptée en particulier pour des bras de levier musculaire efficaces (moment = force de rotation sur une articulation)

Traitement chirurgical des membres inférieurs

Déformation structurale: Ostéotomie

<u>Evaluation de l'antéversion</u> :

- *Clinique:*

- *Scanner*

Traitement chirurgical des membres inférieurs

Déformation structurale: Ostéotomie

Evaluation de la torsion tibiale

- *Clinique:*

- *Scanner*

Traitement chirurgical des membres inférieurs

Déformation structurale: Ostéotomie

<u>Evaluation association</u>

- *Clinique:*

- *Scanner*

Traitement chirurgical des membres inférieurs

Déformation structurale: Ostéotomie

<u>Ostéotomie fémur</u> :

- *Le plus souvent réduire l'antéversion trop importante du col fémoral*
- Génère une marche « rotule en dedans »
- Réduit en particulier le moment du quadriceps

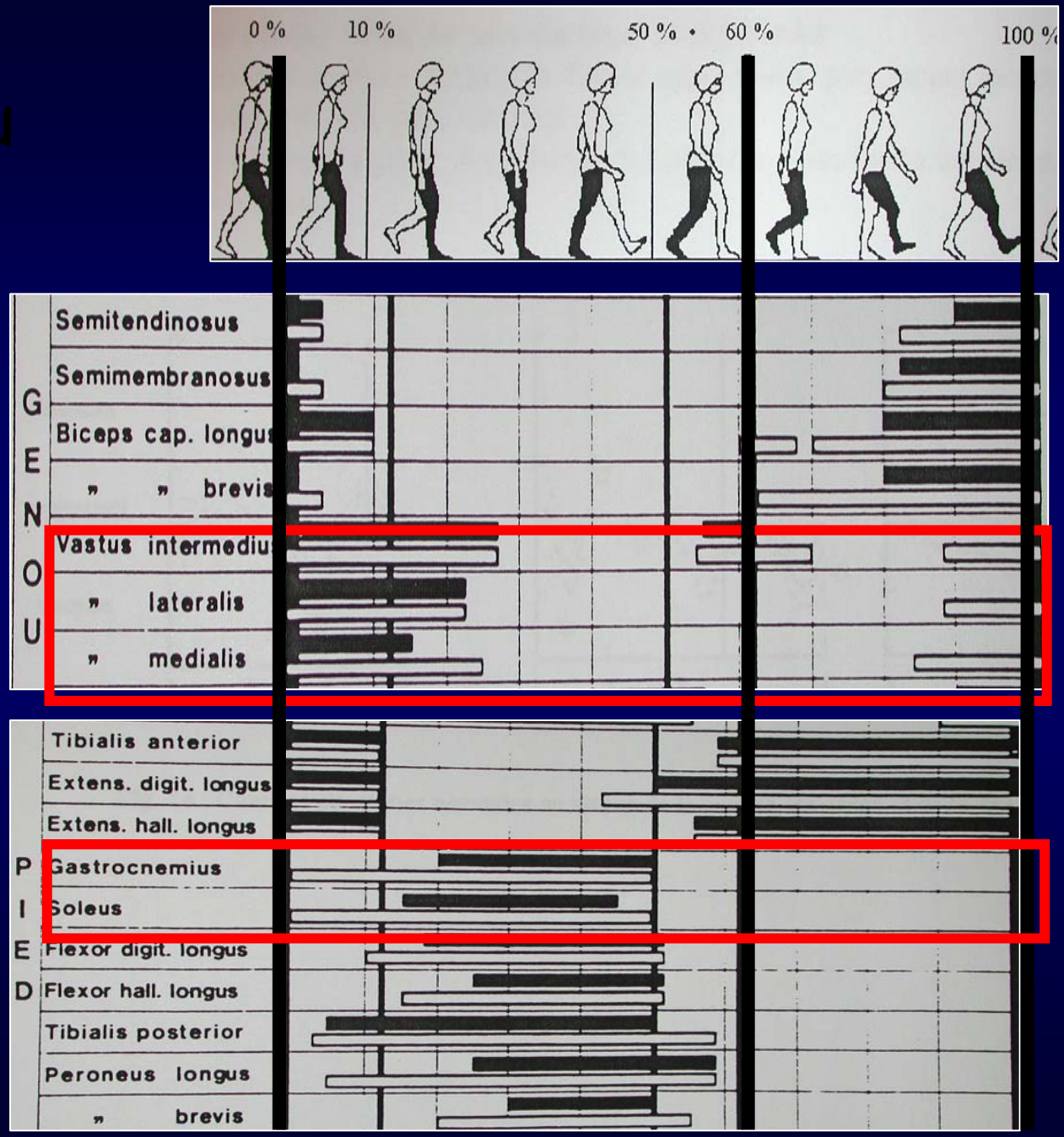
Traitement chirurgical des membres inférieurs

Déformation structurale: Ostéotomie

<u>Ostéotomie Tibia</u> :

- *Mettre le pied sur la ligne de progression lors de la marche*
- Donc à adapter si ostéotomie de fémur
- Restitue en particulier le moment du triceps
- Réduit la contrainte imposée au quadriceps

Genou


0 %
10 %
50 %
60 %
100 %
GENOU
Semitendinosus
Semimembranosus
Biceps cap. longus
" " brevis
Vastus intermedius
" lateralis
" medialis
PIED
Tibialis anterior
Extens. digit. longus
Extens. hall. longus
Gastrocnemius
Soleus
Flexor digit. longus
Flexor hall. longus
Tibialis posterior
Peroneus longus
" brevis

Traitement chirurgical des membres inférieurs

Déformation structurale: Ostéotomie

Ostéotomie Techniques :

- *Décubitus dorsal – Décubitus ventral*
- *Proximal – Distal*
- Clou en fin de croissance
- Plaque quelque soit l'âge
- (ECMES)

Traitement chirurgical des membres inférieurs

Déformation structurale: Ostéotomie

<u>Ostéotomie Age</u> :

Après 7 ans

(Pas de preuve scientifique)

Traitement chirurgical des membres inférieurs

Déformation structurale: Ostéotomie

<u>Ostéotomie: Problème de l'indication quand association :</u>

- *Spasticité*
- *Rétraction*
- *Trouble osseux architectural*

Traitement chirurgical des membres inférieurs

Déformation structurale: Ostéotomie Pied

Ostéotomie Pied:

Le pied constitue l'interface entre le sujet et sol

Importance capitale +++

Traitement chirurgical des membres inférieurs

Flexum de genou

Traitement chirurgical des membres inférieurs

Flexum de genou : Angle mort

Traitement chirurgical des membres inférieurs

Flexum de genou

Traitement chirurgical des membres inférieurs

Flexum de genou: « Intervenants

- *Quadriceps*
- *Ischio-jambiers*
- *Triceps*

Traitement chirurgical des membres inférieurs

Flexum de genou: « Intervenants

Traitement chirurgical des membres inférieurs

Flexum de genou

Préventif:

- *Kinésithérapie*
- *Parfois attelles de Posture*
- *Parfois la toxine botulique*

Curatif:

- *Parfois série de plâtre*
  - *Met les muscles spastiques au « repos »*
  - *Gypsotomies*

Peuvent être réalisé en post-op.

- *Chirurgie*

Traitement chirurgical des membres inférieurs

Flexum de genou: Chirurgie

Parties molles:

- *Allongement parcimonieux des IJ*
- *Si Â mort: Accourcissement tendon patellaire*
- *Capsulotomie*
- *« Gestion du triceps »*

Osseuse:

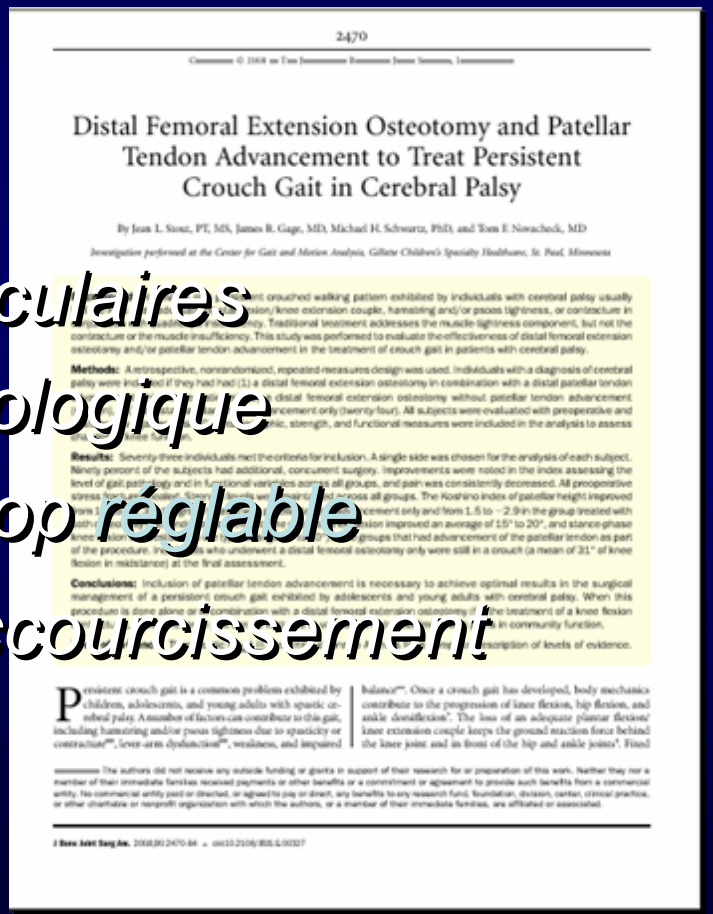
- *Ostéotomie d'extension distale du fémur*

Traitement chirurgical des membres inférieurs

Flexum de genou: Chirurgie Osseuse

Haut risque:

- *Attention au troubles vasculaires*
- *Attention au trouble neurologique*
- *Intérêt d'une attelle post-op réglable*
- *Toujours y associer un accourcissement du tendon patellaire*



2470

Distal Femoral Extension Osteotomy and Patellar Tendon Advancement to Treat Persistent Crouch Gait in Cerebral Palsy

By Jean L. Stout, PT, MS, James R. Gage, MD, Michael H. Schwartz, PhD, and Tom F. Novacheck, MD

Investigation performed at the Center for Gait and Motion Analysis, Gillette Children's Specialty Healthcare, St. Paul, Minnesota

Methods: A retrospective, nonrandomized, repeated-measures design was used. Individuals with a diagnosis of cerebral palsy were included if they had had (1) a distal femoral extension osteotomy in combination with a distal patellar tendon advancement or (2) a distal femoral extension osteotomy without patellar tendon advancement ... cement only (twenty-four). All subjects were evaluated with preoperative and ... strength, and functional measures were included in the analysis to assess ...

Results: Seventy-three individuals met the criteria for inclusion. A single side was chosen for the analysis of each subject. Ninety percent of the subjects had additional, concurrent surgery. Improvements were noted in the index assessing the level of gait pathology and in functional variables across all groups, and pain was consistently decreased. All preoperative ... Knoshino index of patellar height improved ... cement only and from 1.5 to −2.9 in the group treated with ... ion improved an average of 15° to 20°, and stance-phase ... groups that had advancement of the patellar tendon as part of the procedure. In ... who underwent a distal femoral osteotomy only were still in a crouch (a mean of 31° of knee flexion in midstance) at the first assessment.

Conclusions: Inclusion of patellar tendon advancement is necessary to achieve optimal results in the surgical management of a persistent crouch gait exhibited by adolescents and young adults with cerebral palsy. When this procedure is done alone or in combination with a distal femoral extension osteotomy, ... the treatment of a knee flexion ... in community function.

... description of levels of evidence.

Persistent crouch gait is a common problem exhibited by children, adolescents, and young adults with spastic cerebral palsy. A number of factors can contribute to this gait, including hamstring and/or psoas tightness due to spasticity or contracture[1,2], lever-arm dysfunction[3,4], weakness, and impaired balance[5,6]. Once a crouch gait has developed, body mechanics contribute to the progression of knee flexion, hip flexion, and ankle dorsiflexion[7]. The loss of an adequate plantar flexion–knee extension couple keeps the ground reaction force behind the knee joint and in front of the hip and ankle joints[8]. Fixed

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J Bone Joint Surg Am. 2008;90:2470-84 ... doi:10.2106/JBJS.G.00327

Traitement chirurgical des membres inférieurs

Flexum de genou: Chirurgie Osseuse

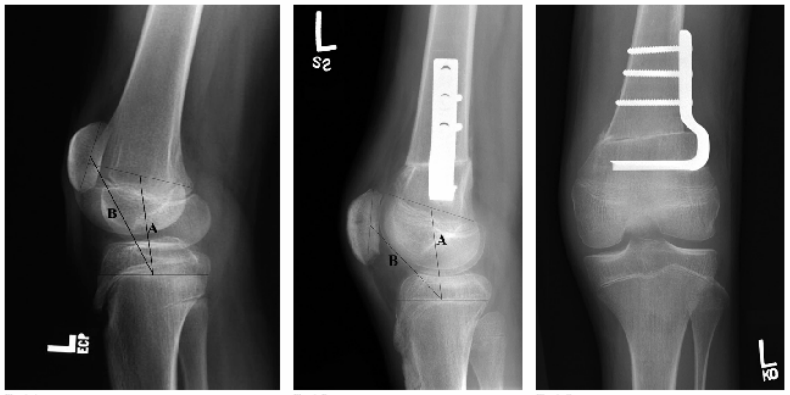

Fig. 1-A Fig. 1-B Fig. 1-C

Preoperative (Fig. 1-A) and postoperative (Fig. 1-B) lateral radiographs and postoperative anteroposterior radiograph (Fig. 1-C) of a left knee in maximum extension in the group treated with both distal femoral extension osteotomy and patellar tendon advancement. The position of the AO blade-plate is seen postoperatively (Figs. 1-B and 1-C). Any posterior bone protrusion on the distal fragment of the osteotomy is removed (Fig. 1-B). To calculate the Koshino index[53] of patellar height, the femur-tibia distance (A) and the patella-tibia distance (B) are measured with use of the epiphyseal line midpoints of the tibia and femur and the midpoint of the long axis of the patella. The Koshino index is the ratio of B to A. The typical ratio is dependent on the knee flexion angle seen on the radiograph. In this case, the preoperative ratio (Fig. 1-A) is 1.34 with a knee flexion angle of 15°, and the postoperative ratio (Fig. 1-B) is 1.08 with a knee flexion angle of 0°.

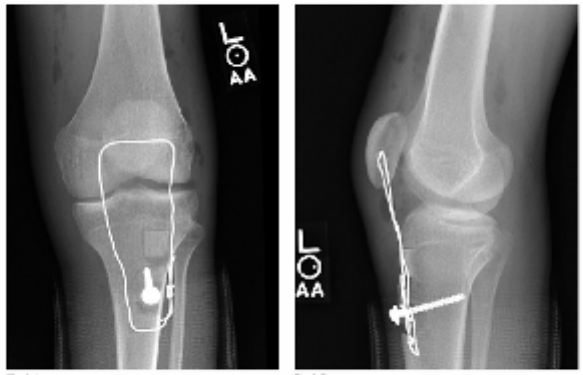

Fig. 2-A Fig. 2-B

Anteroposterior (Fig. 2-A) and lateral (Fig. 2-B) radiographs of a knee. A minimum excess on following patellar tendon and tibial tubercle advancement. The tibial tubercle was removed as a piece of bone. A hole was created distally for the tibial tubercle by removing the cortical surface. (This cortical piece is typically repositioned proximally to the original site of the tibial tubercle and impacted into position.) The tubercle is advanced until the distal pole of the patella is at the joint line. The entire repair in this patient is protected by a 16-gauge stainless steel Luque-wire tension band placed transversely through the patella and through a transverse drill hole in the tibia and tightened. When Luque wire is used, it is typically removed six to eight weeks after the surgery. Currently, FiberTape is used as tension band and remains and typically is not removed.

Traitement chirurgical des membres inférieurs

Flexum de genou: *Chirurgie Osseuse*

- *Moins risqué*: *Epiphysiodèse*

ORIGINAL ARTICLE

Guided Growth for Fixed Knee Flexion Deformity

Joshua Klatt, MD and Peter M. Stevens, MD

J Pediatr Orthop 2008;28:626–631)

Background: Fixed knee flexion deformity (FKFD) is an insidious problem that may complicate the management of patients with neuromuscular compromise due to cerebral palsy, spina bifida, arthrogryposis, and other conditions. The energy costs associated with crouch gait may become prohibitive and, with the inexorable progression of fixed knee flexion, secondary pain may ensue as a result of fragmentation of the patella and/or tibial tubercle. Concomitant or compensatory flexion deformity of the hips and lumbar lordosis may develop, along with "pseudo equinus" of the ankles. Recommended treatments for FKFD have included bracing, physical therapy, and, in recalcitrant cases, distal femoral osteotomy, posterior release, or frame distraction. However, these latter modalities are fraught with potential complications including neurovascular damage, loss of fixation, undercorrection/overcorrection, fracture, and recurrent deformity. Considering that FKFD is often bilateral, the complication risks for a given patient are doubled. In a previous study, the senior author reported successful hemiepiphysiodesis of the distal anterior femur using staples. However, further experience has demonstrated some of the limitations of stapling including relatively slow correction and occasional hardware migration. This led to the development of a more versatile and reliable solution using a pair of anterior tension band plates.

Methods: In this retrospective clinical study, we are reporting this new technique of promoting gradual correction through guided growth of the distal femur, using a pair of anterior 8-plates. The correction is accomplished simultaneously and bilaterally, without hemiepiphysiodesis, and may be combined with other operative procedures as indicated. We reviewed the charts, radiographs on a group of patients treated accordingly.

Results: In this group of 18 patients with 26 deformities, we noted correction averaging 1.3 degrees (range, 0–9 [1 patient]–4.8 degrees), with minimal complications. No undercorrected coronal plane deformities were created. Upon full correction, the plates were removed so as to avoid recurvation.

Conclusions: As an alternative to posterior capsulotomy or supracondylar extension osteotomy, we have found that guided growth is an effective and safe method of gradually correcting FKFD in growing children and adolescents.

Level of Evidence: 4 (retrospective clinical series)

Key Words: crouch gait, fixed knee flexion deformity, guided growth, hemiepiphysiodesis, cerebral palsy, spina bifida, arthrogryposis, 8-plate

From the Department of Orthopaedics, University of Utah, Salt Lake City, UT.

The authors received no financial support for this study.

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Fixed knee flexion deformities (FKFD) may present as a significant problem in patients with diverse etiologies including cerebral palsy, myelodysplasia, and arthrogryposis.[1–3] Despite nonoperative management, FKFDs that are initially mild may progress, interfering with ambulation. As a given deformity surpasses 15 degrees, gait kinematics are compromised and symptoms ensue, including decreased endurance due to quadriceps fatigue, anterior knee pain, and progressive crouch gait.[2,3] There may be compensatory and concurrent hip flexion deformity accompanied by lumbar lordosis, as well as functional equinus. As opposed to dynamic contractures, FKFD cannot be successfully managed by serial casts, spasticity management (Botox/Baclofen), and floor reaction or even above knee bracing. With respect to wheelchair ambulators, FKFD can lead to difficulties with standing for transfers, dressing, bathing, and activities of daily living.

When conservative management including stretching, physical therapy, spasticity management, and bracing fail, there are several surgical options, some of which are comparatively aggressive and fraught with potential complications. These include posterior capsulotomy, extension supracondylar osteotomy, and frame distraction.[4] Because many of these deformities are bilateral, this results in higher perioperative risks and protracted recovery. Furthermore, recurrent deformity with continued growth is common, making these relatively invasive techniques less appealing.

The previously described technique of anterior femoral stapling for flexion deformity[5,6] has been refined by using a pair of nonlocking plates that are strategically placed (nonarticular) on either side of the patellofemoral sulcus. This article relates our preliminary results, pointing out the rationale and potential advantages of a flexible tether.

METHODS

To date, 23 patients (40 knees) have been treated using this method. Diagnoses included cerebral palsy (12), spina bifida (5), unknown neuromuscular syndromes (2), arthrogryposis (1), teratologic (1), traumatic sciatic nerve injury (1), and Stickler syndrome (1). The average patient age at the time of initial surgery was 10.8 years (range, 4–17 years). The youngest child was an outlier with a teratologic knee flexion deformity. Otherwise, the youngest age at surgery was 8 years.

Clinical assessment included gait evaluation, straight leg raise, and screening for concomitant deformities such as scoliosis, limb length discrepancy, and angular or rotational deformities of the legs. In addition to the typical supine straight leg raise examination, it is helpful to put the patient

FONDAMENTAL

- Importance de la chirurgie multiétagée en un temps (ou deux)
- Rééducation longue en centre de rééducation
  - Doit être acceptée avant toute chirurgie multi étagée
  - Longue (3 à 6mois)
  - Préparer les phases difficiles post-op. inévitables
- Mobilisation et verticalisation très précoces
  - Eviter la perte de force musculaire et la raideur
- Attention à la séquence Douleur–Spasticité–Douleur…

Généralités

ATTENTION + + +

- Enfants avec faiblesse musculaire
- Enfants avec troubles de l'équilibre

Généralités

ATTENTION + + +

- Enfants dystoniques + + +
- Enfants avec troubles végétatifs

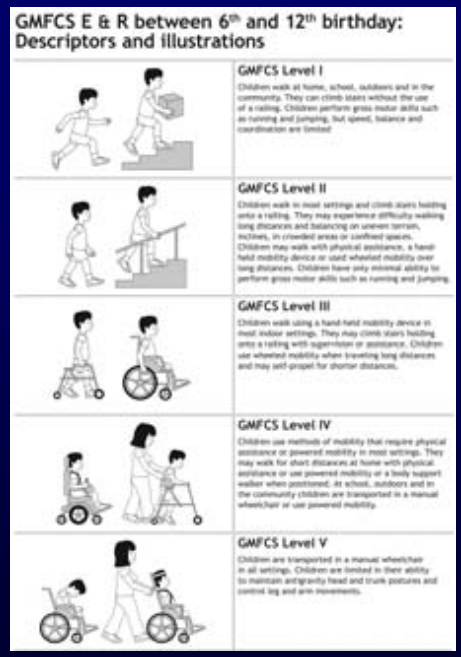
Traitement chirurgical des membres inférieurs

Luxation de hanche

→ Il faut évaluer la hanche chez tout enfant présentant une PC

(Tous les 6 mois si excentration découverte récemment)

→ Important d'annoncer aux parents l'histoire naturelle de la luxation de hanche



Traitement chirurgical des membres inférieurs

Luxation de hanche

→ Il faut évaluer la hanche chez tout enfant présentant une PC

(Tous les 6 mois si excentration découverte récemment)

→ Important d'annoncer aux parents l'histoire naturelle de la luxation de hanche

→ Importance pour éviter toute arthrose prématurée

Traitement ultérieur de la douleur très difficile

- Prothèse
- Résection Tête-Col
- Butée ?

Traitement chirurgical des membres inférieurs

Luxation de hanche

→ Intérêt de la posture et de la verticalisation

→ Pas d'intérêt de la toxine botulique

→ Intérêt de la libération des parties molles (« adducteurs »)

<30% découverture (indice de Reimers)


JB&JS

Does Botulinum Toxin A Combined with Bracing Prevent Hip Displacement in Children with Cerebral Palsy and "Hips at Risk"? A Randomized, Controlled Trial


SOFT-TISSUE RELEASES TO TREAT SPASTIC HIP SUBLUXATION IN CHILDREN WITH CEREBRAL PALSY

Traitement chirurgical des membres inférieurs

Luxation de hanche

Si >30% :

→ Ne pas attendre la luxation invétérée

Traitement chirurgical des membres inférieurs

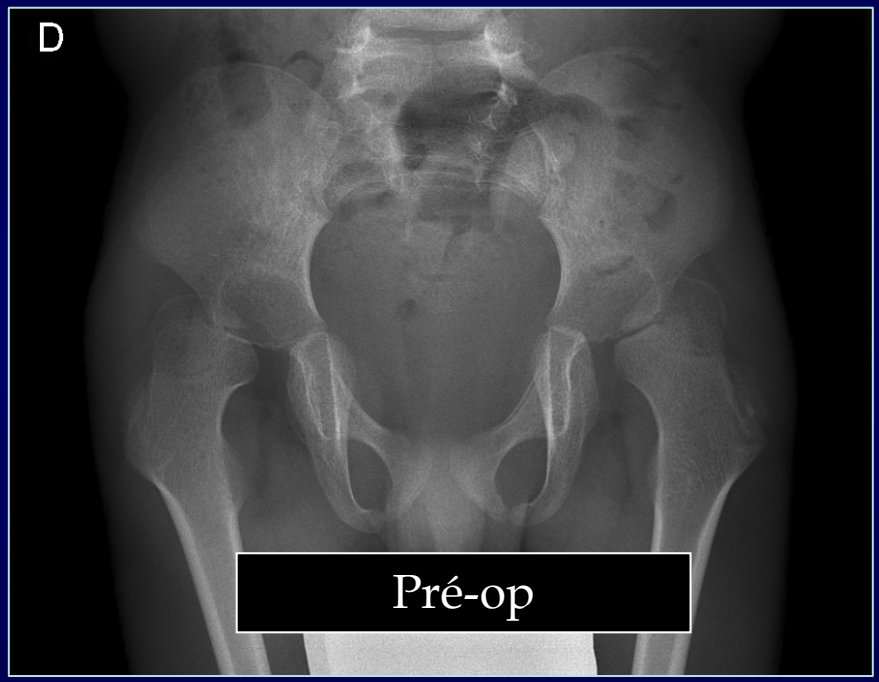
Luxation de hanche: Techniques

→ Varisation dérotation fémorale proximale

→ Ostéotomie pelvienne

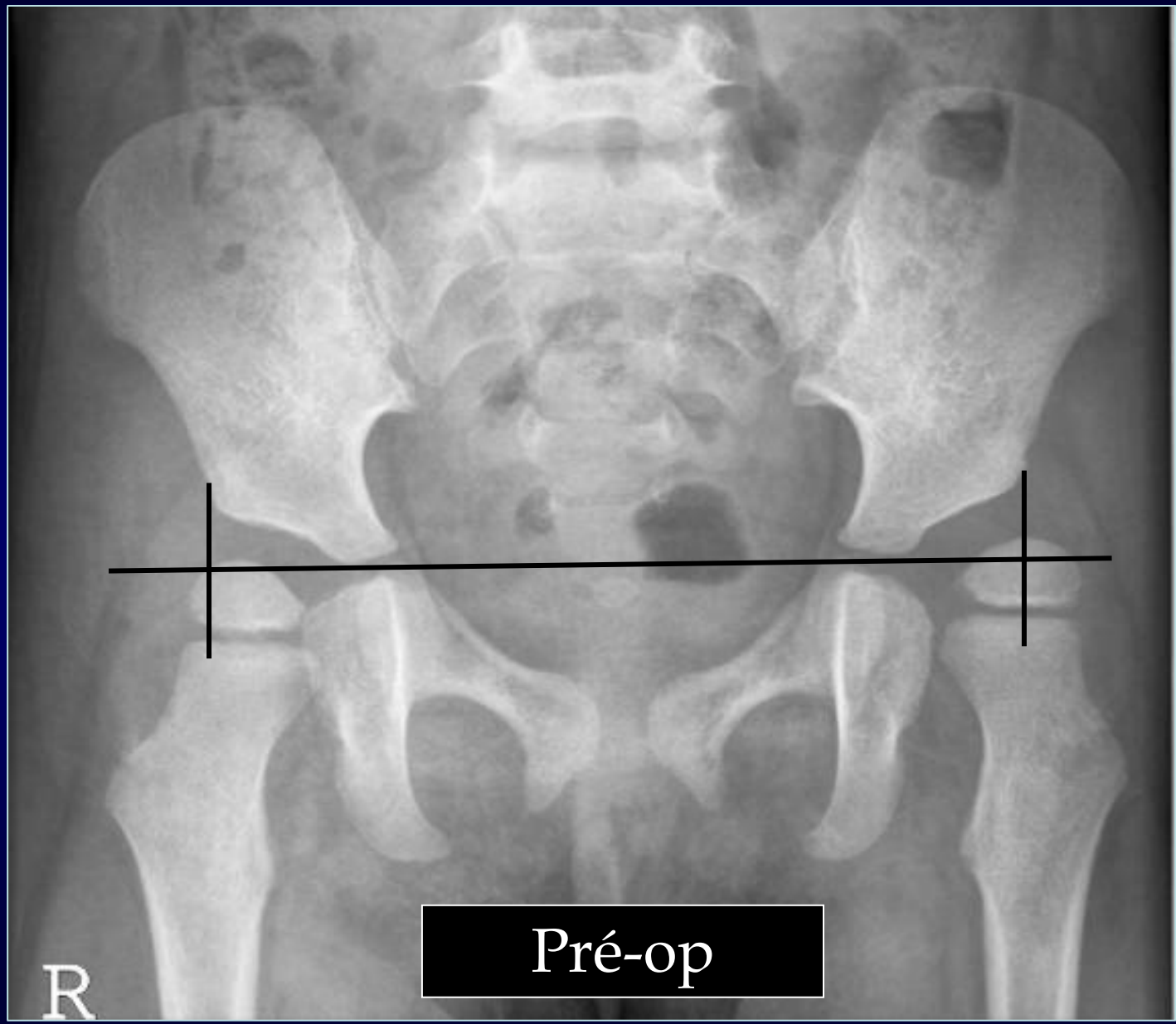
- San Diego (ou « Like »)
- Dega
- Chiari (si insuffisance de couverture prévisible)
- Butée

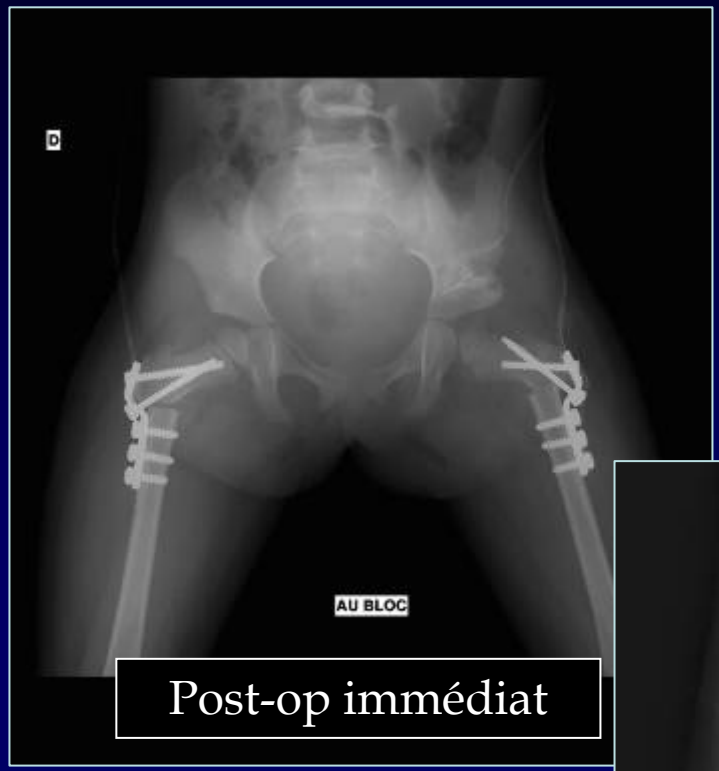
La chirurgie bilatérale s'impose dans le même ou légèrement différé


D
Pré-op


AU BLOC
D
Post-op immédiat


D
1 an


Pré-op
R



Post-op immédiat

Post-op 2 ans

Post-op 3 ans

Traitement chirurgical des membres inférieurs

Luxation de hanche: Immobilisation

→ Traction

→ Aucune contention

→ Plâtre PPP

- Antalgique en post-op. (++ Médecins rééducateurs)
- Posture avant coque mousse en abduction
- Problème différé de la douleur à l'ablation
- Problème de la fragilité osseuse

Traitement chirurgical des membres inférieurs

Appareillage

→ Posture (évite les positions vicieuses)

→ Attelle fonctionnelle de marche

Assez souvent mal accepté par les enfants

Problèmes de la fonte musculaire

Traitement chirurgical du RACHIS

Scoliose

→ Le plus souvent aspect neurologique avec grande courbure

→ Parfois aspect courbure idiopathique

Gestion +++ de l'obliquité du bassin et du tronc (Confort, Escarre)

Traitement chirurgical du RACHIS

Scoliose

→ Aucune prévention

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The Risk of Progression of Scoliosis in Cerebral Palsy Patients After Intrathecal Baclofen Therapy

Hakan Senaran, MD,*† Suken A. Shah, MD,* Ana Presedo, MD,* Kirk W. Dabney, MD,*
Joseph W. Glutting, PhD,* and Freeman Miller, MD*

Study Design. Retrospective radiographic and medical chart review with matched control group.

Objective. To identify the effect of intrathecal baclofen on the incidence of scoliosis, rate of curve progression, and pelvic obliquity compared with a matched cohort.

Summary of Background Data. Although intrathecal baclofen therapy (ITB) has been shown to be effective in decreasing spasticity, case reports have described some children receiving ITB in whom progressive scoliosis was noted; other authors have described no effect on the spinal column. A controlled study has not been performed.

Methods. All patients with spastic CP treated with ITB between 1997 and 2003 at a single institution were reviewed. A total of 107 patients undergoing ITB for a minimum of 2 years were identified, of which 26 patients subsequently developed or had progression of scoliosis. Twenty-five age, gender, and gross motor function classification system (GMFCS) score-matched quadriplegic CP patients with scoliosis who did not receive ITB constituted the control group used to compare the rate of curve progression and pelvic obliquity.

Results. The average curve progression for the baclofen group after pump implantation was 16.3° per year; and for the control group was 16.1° per year. Both groups' curves progressed over time during growth ($P = 0.001$), but baclofen did not have an independent effect on curve progression ($P = 0.181$). Average pelvic obliquity for the 2 groups increased over time ($P = 0.001$), but there was no difference between the groups ($P = 0.536$). Twelve of 57 patients (21%) developed scoliosis after pump implantation during a mean of 3.6 years of follow-up. Thirty of 92 matched control patients (32%) not treated with ITB within the same time interval had scoliosis by maturity.

Conclusion. This study demonstrates that ITB has no significant effect on curve progression, pelvic obliquity, or the incidence of scoliosis when compared with an age, gender, and GMFCS score-matched control group of patients with spastic CP without ITB.

Key words: intrathecal baclofen, scoliosis, cerebral palsy, pelvic obliquity. **Spine 2007;32:2348–2354**

Baclofen, a γ-aminobutyric acid agonist, is a mediator that acts at the cerebral and spinal cord levels to impede the release of excitatory neurotransmitters that cause spasticity.[1] Baclofen can be administered orally or as an intrathecal infusion. Oral baclofen improves cerebral spasticity only to a mild degree[1,2]; however, intrathecal baclofen therapy (ITB) is effective for children with cerebral spasticity in reducing muscle tone.[3–7] Outcomes of ITB for patients with spasticity are: improvement in function, facilitation of care, decrease or prevention of contractures, and a decrease in pain associated with contractures.[8–12] The improvement in spasticity can persist for years.[4]

Scoliosis and sagittal plane spinal deformities are significant problems in patients with cerebral palsy (CP).[13–17] A progressive scoliosis can lead to difficulty in sitting due to coronal imbalance, loss of head control and upper extremity use, pain, and skin breakdown. Although ITB has been shown to be effective in decreasing spasticity, its effect on the spinal column of children with spastic CP has not been well defined. Some investigators report concerns of scoliosis progression after ITB,[16,17] while others have not noted progression beyond that associated with the natural history of this patient population. Two theories of thought prevail. ITB may contribute to loss of truncal tone, leading to difficulty with upright posture and cause development and/or progression of spinal deformity. On the other hand, decreasing spasticity may help to balance forces on either side of the spine by reducing tone in the paraspinal and postural muscles and may protect the patient from development or progression of scoliosis.

Focusing on a series of children with spastic CP who had ITB at a single institution, the purposes of this study were to test the hypotheses that intrathecal baclofen has an effect on the incidence of scoliosis, the rate of curve progression, and the magnitude of pelvic obliquity.

Materials and Methods

All patients with spastic cerebral palsy who were treated with ITB between 1997 and 2003 were reviewed. Approval from our Institutional Review Board was obtained. Gender, age, ambulatory potential, and pattern of spasticity were noted. The ambulatory potential of the patients was categorized according to the gross motor function classification system (GMFCS) described by Palisano *et al*[18] and muscle tone was categorized by the modified Ashworth scale.[19] Standard posteroanterior and lateral radiographs were taken with the patient sitting erect. Those who could not sit independently were positioned in special adaptive seat with straps to allow them to sit erect, but no

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The device(s)/drug(s) is/are FDA-approved or approved by corresponding national agency for this indication.
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Traitement chirurgical du RACHIS

Scoliose : Techniques

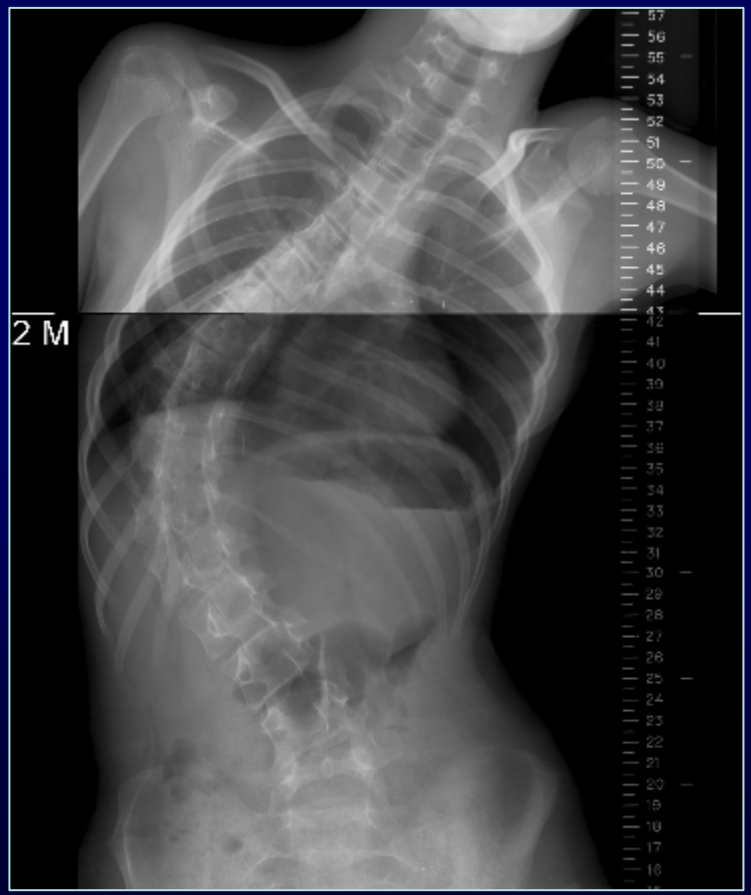
→ Prendre le bassin si oblique

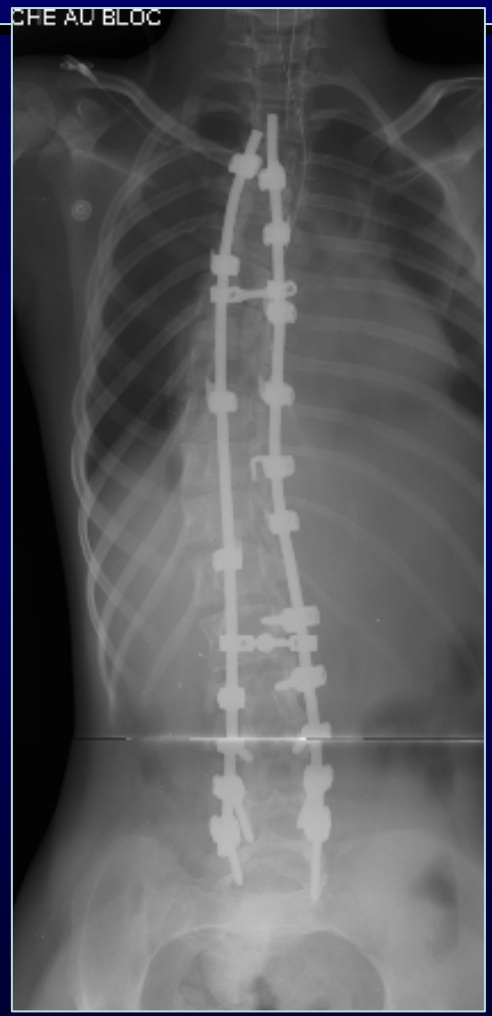
→ Unit Rod (prix, excellence de la correction)

Surgical Correction of Scoliosis in Pediatric Patients With Cerebral Palsy Using the Unit Rod Instrumentation

Traitement chirurgical du RACHIS

Scoliose : Techniques





Traitement chirurgical du Mb supérieur

Membre supérieur

→ Difficile sur le plan fonctionnel car:

Main(s) négligée(s)

→ Confort (arthrodèse du poignet)

MERCI DE VOTRE ATTENTION