

# Anatomie et biomécanique de l'épaule

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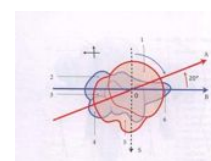
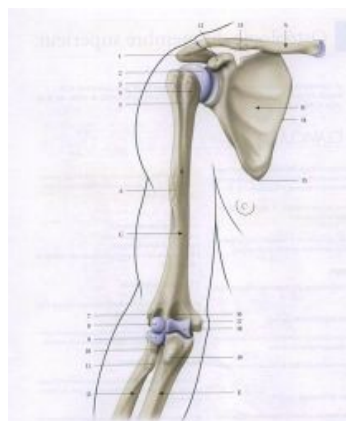
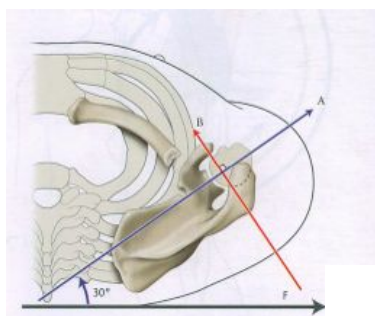


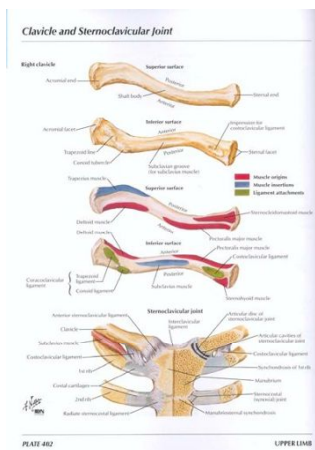
## DÉFINITION

L'épaule est la jonction entre le tronc et le membre thoracique, qui est un membre suspendu

## Les Acteurs

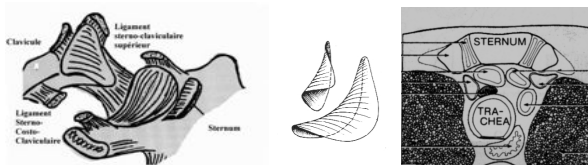
- Les os
- Les articulations
- Les muscles et tentons





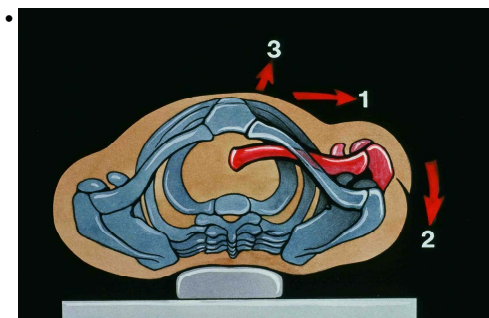
## Les articulations

### ARTIC STERNO-COSTO-CLAVICULAIRE



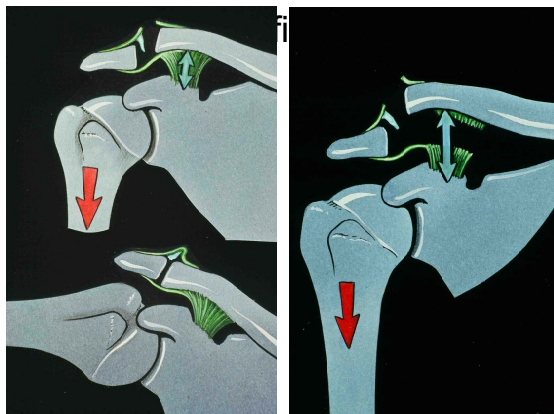
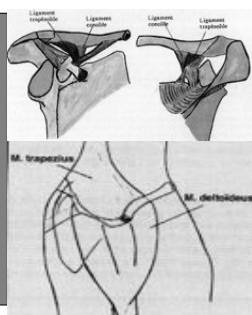
- Articulation en selle
- Ménisque
- Ligaments très puissants (sternoclaviculaire, costoclaviculaires)
- Proximité des vaisseaux

### Postérieure

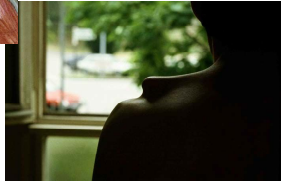
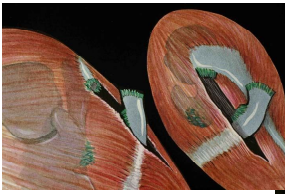


### ARTIC ACROMIO-CLAVICULAIRE

- Articulation plane ou arthroïdie
- Disque intra-articulaire
- Ligaments :
  - acromio-claviculaire
  - coraco-claviculaire
- Mobilité: glissement (axe vertical) compas scapulo-claviculaire
- Nécessité d'une chape delto-trapézienne intacte



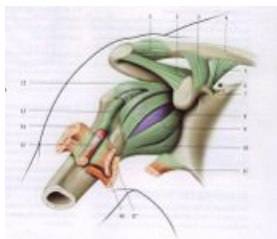
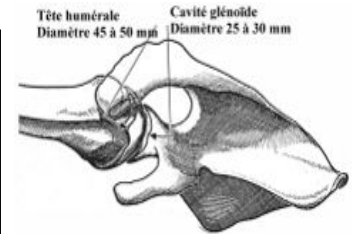
## Stade V



GRAL

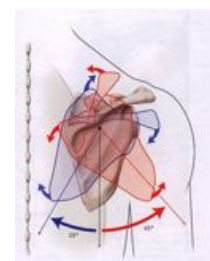
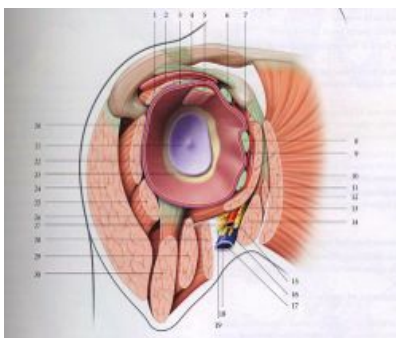
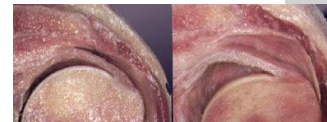
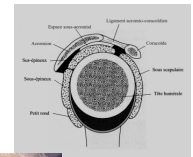
## ARTIC GLÉNO-HUMÉRALE

- Énarthrose instable
- Compromis permanent entre stabilité et mobilité

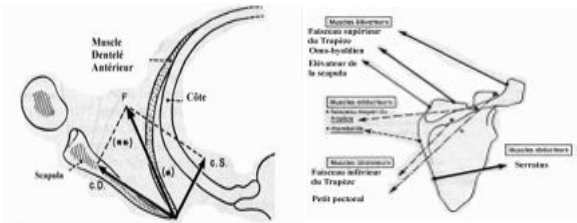


## BOURSE SOUS-ACROMIALE

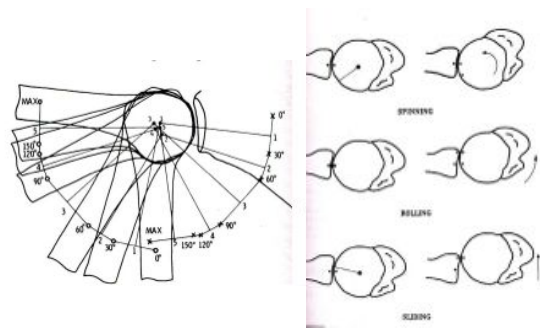
- Bourse: défilé ostéo-fibreux
- Facilite le glissement de la coiffe des rotateurs sous l'arc coraco-acromial



## ARTICULATION SCAPULO-THORACIQUE



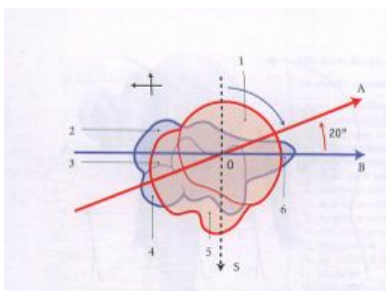
## Particularité de l'épaule



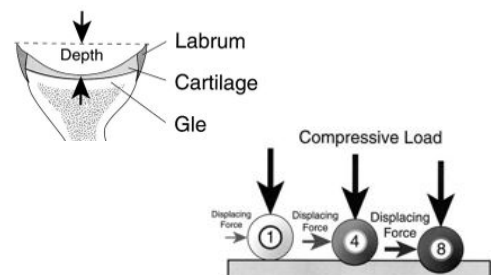
## La stabilité

Les facteurs osseux

## La rétroversion



## La concavité



## Le labrum

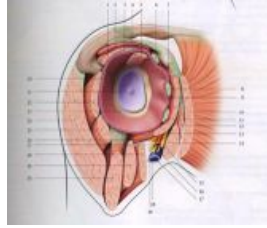
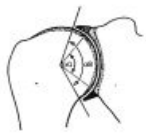
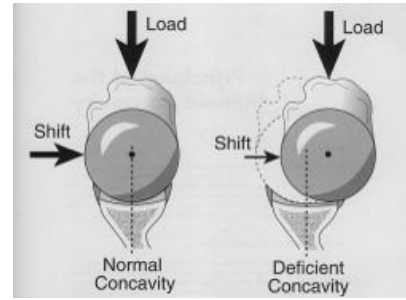


Figure N°4 :  
 Angle I : % de couverture de la tête humérale par la glène osse (50%)  
 Angle II : % de couverture de la tête humérale par l'ensemble glène / labrum (72%)



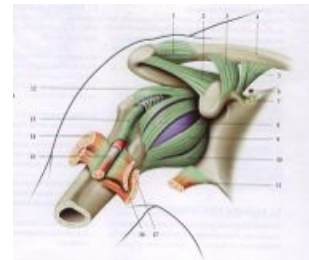
## Variations anatomiques

### Foramen Labral

- 15 à 40%
- Non-insertion du labrum en zone 2
- Communication avec le récessus sous-scapulaire



## Les Ligaments gléno-huméraux



## SYSTÈME LIGAMENTAIRE

- Ligaments gléno-huméraux
  - Supérieur
  - Moyen
  - Inférieur
- Ligament coraco-huméral
- En arrière : épaissement de la capsule



## Ligament gléno-huméral supérieur (LGHS)

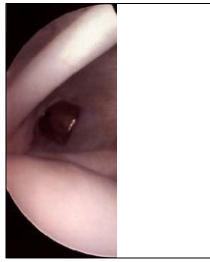
- Glène - Tubercule mineur
- En avant du sillon
- Intervalle des rotateurs  
+++





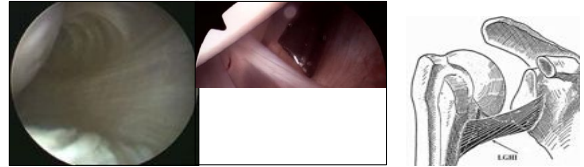
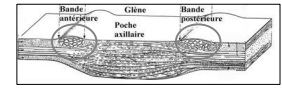
## Ligament gléno-huméral moyen (LGHM)

- Epaisseur variable
- Croise le muscle sub-scapulaire
- Variations anatomiques



## Ligament gléno-huméral Inférieur (LGHI)

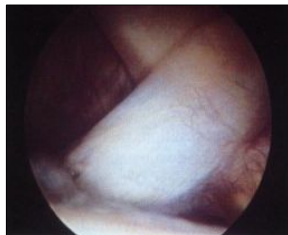
- Important +++
- Résistant +++
- Hamac - 2 Cordes



## Ligaments gléno-huméraux

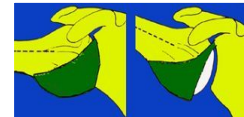
Variation anatomique:  
Buford Complex

- 1,5 %

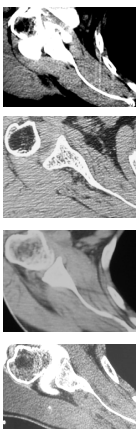
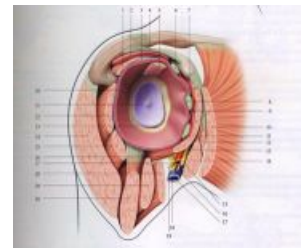
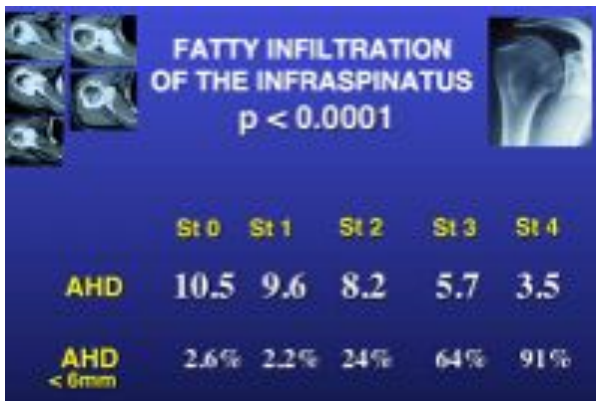
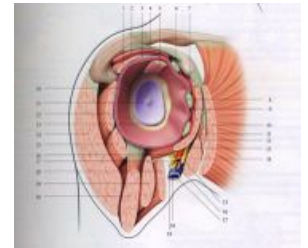
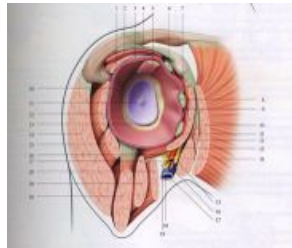


## STABILITÉ GLÉNO-HUMÉRALE

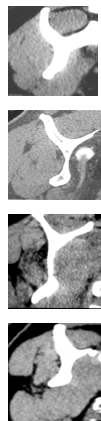
- La première structure stabilisatrice : complexe capsulo-ligamentaire
- Abduction: les contraintes - LGHI (51%), le LGHS(22%), le ligament coraco-huméral (18%) et le LGHM(9%)
- LGHI tendu au maximum : armé du bras
- Insertions du labrum et du LGHI : zones de fragilité - se focalisent les contraintes mécaniques



## Les muscles & tendons



**Normal**



**Hypertrophy**

**Atrophy**

**Absent**

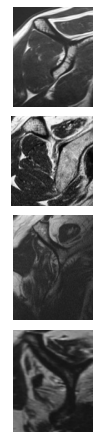


**Normal**

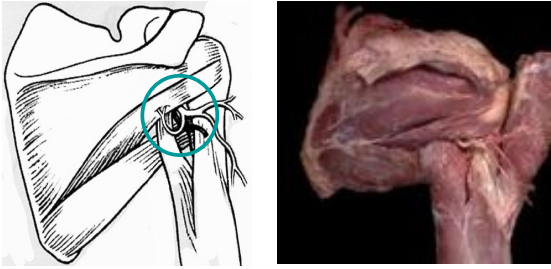
**Hypertrophy**

**Atrophy**

**Absent**

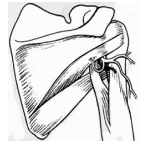


## Quadrilateral space syndrom



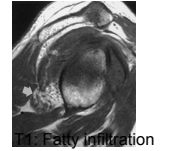
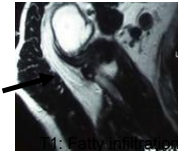
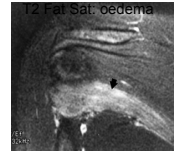
Fibrous band (thrower), humeral or scapula fract,  
ant or post dislocation inferior labral cyst

## Still many doubts....



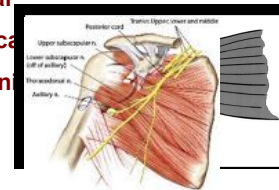
Atrophy, œdema or fatty infiltration

- Open surgery (capsulorrhaphy, post bone block...)
- Arthroscopy ( post inf capsulorrhaphy, shrinkage)
- Other causes ....?



## The subscapularis

- Anatomical
- Neurological
- Biomechanical



(Keating JF, et al. JBJS Br 1993)

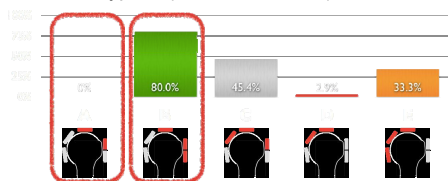
(Klapper RC, et al. AJSM 1992) (Cleeman E, et al. JSES 2003)

(Kato K. Anat Anz 1989) (Tubbs RS, et al. Clin Anat 2007)

(Kasper JC, et al. JSES 2008)

## Pseudo-paralysis

- 80% of type B (SSP + entire SSC)
- 50% of type C (SSP + ISP + SSC sup.)
- 33% of type E (SSP + ISP + TM)



Correlation of the Involved Compartments of Massive Rotator Cuff Tear and Loss of Active Shoulder Range of Motion

Author Block: Philippe Collin; Noboru Matsumura; Gilles Walch

AAOS  
AMERICAN ACADEMY OF  
ORTHOPAEDIC SURGEONS

## TENDON DU CHEF LONG DU BICEPS

- Insertion : Tubercule supra glénoidien et labrum (zone 1)
- Intra/extra articulaire
- Sillon intertuberculaire
- Coiffe des rotateurs





## TENDON DU CHEF LONG DU BICEPS

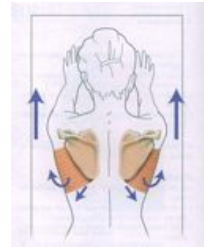
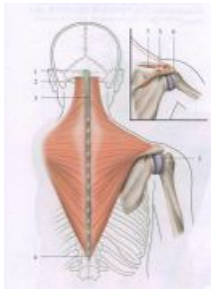
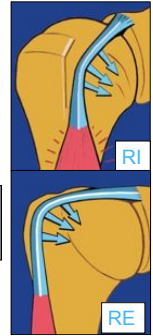
- muscle présentant le plus de variations du corps humain (Macalister, 1875)
- Rodriguez-Niedenführ et al.: 15,5% de variations (dissection de 175 cadavres)
- Depuis une agénésie à 7 chefs



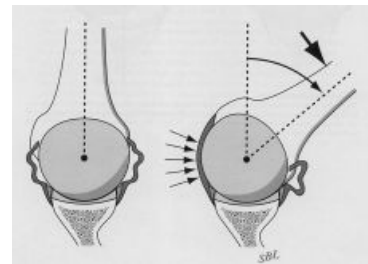
## Anatomie-physiopathologie

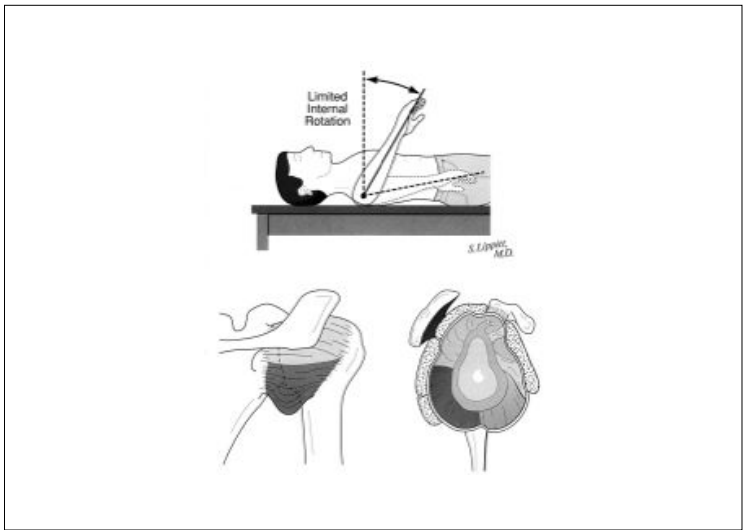
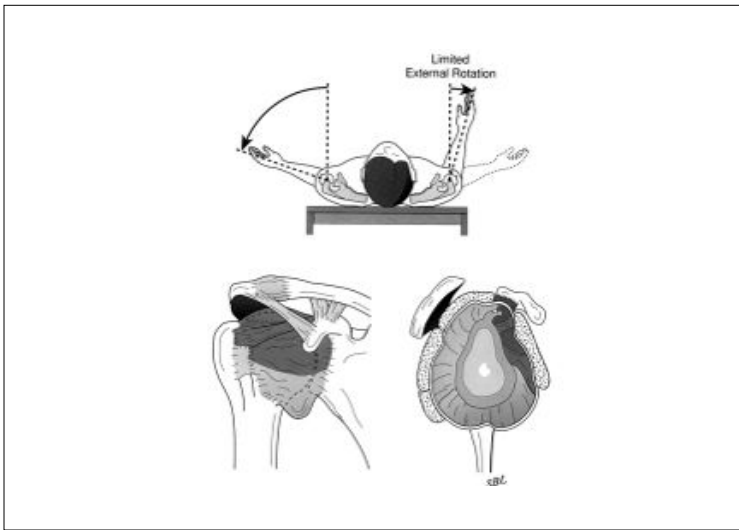
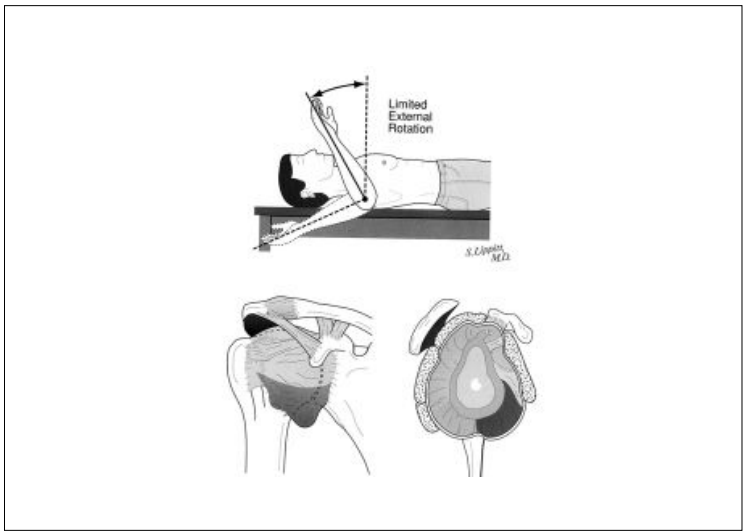
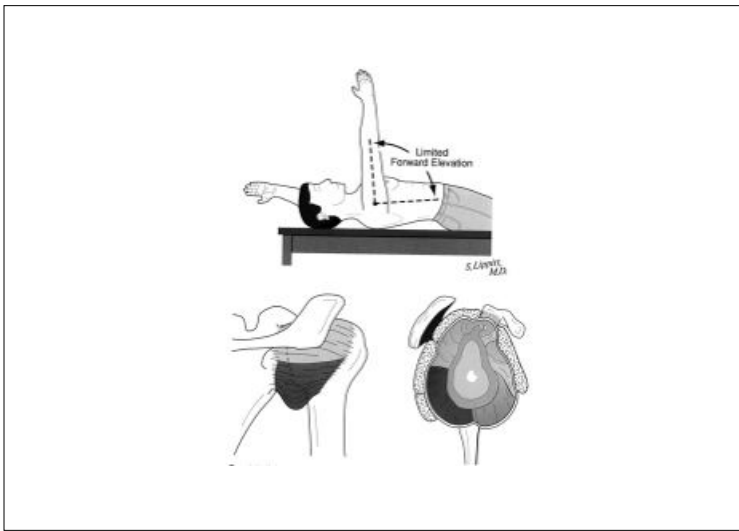
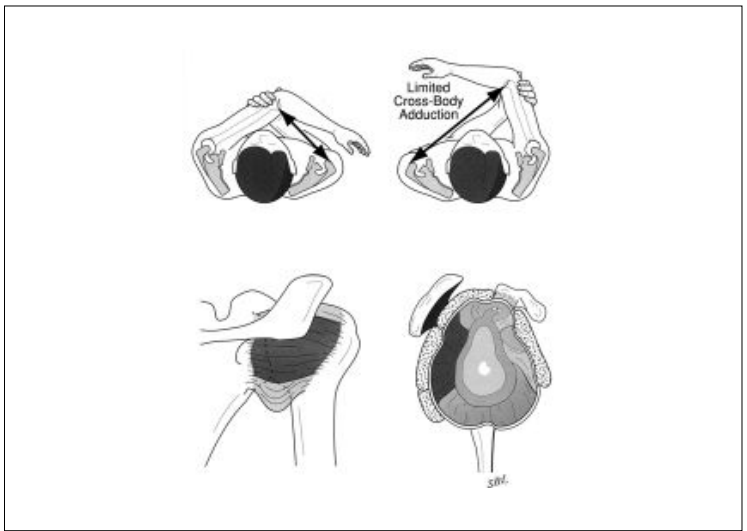
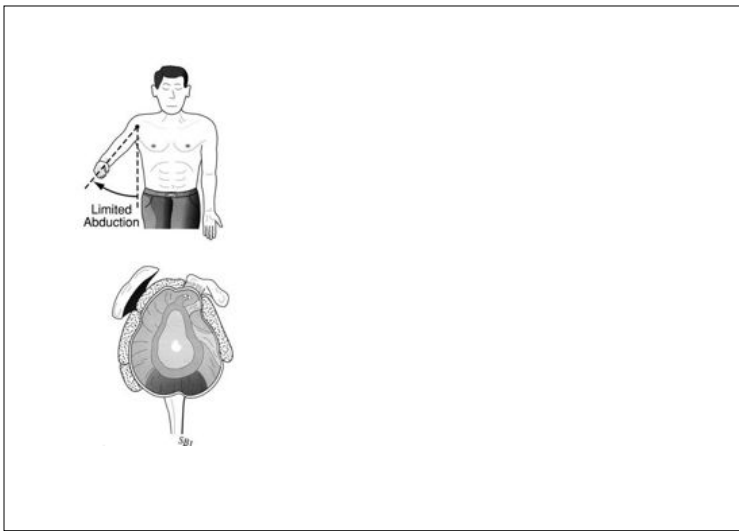
Quelque soit la rotation de l'articulation glénohumérale, le biceps a tendance à se luxer médialement !!!

- Poulie
- Insertion du sub-scapulaire



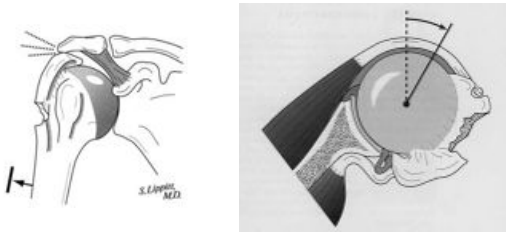
## La mobilité





## La mobilité

- Déficit passif lié à problème osseux

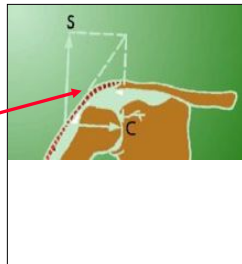


## La mobilité ACTIVE

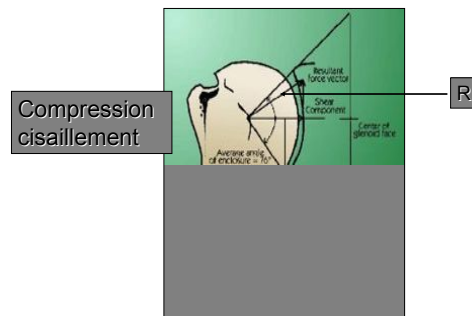
### MOBILITÉ GLÉNO-HUMÉRALE

#### • Deltôïde :

- Le plus puissant
- Peut développer 6\* le pds du MS
- Il produit une F ascendante (=cisaillement)

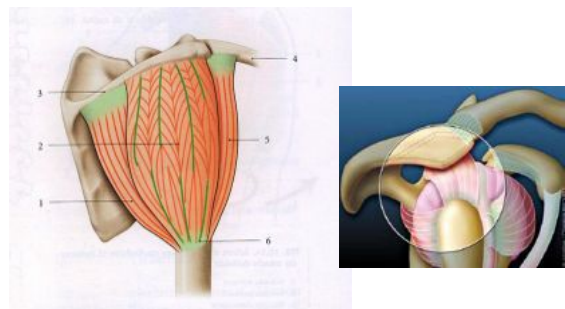
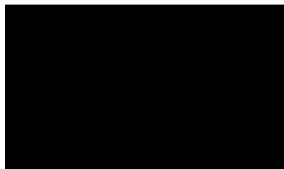


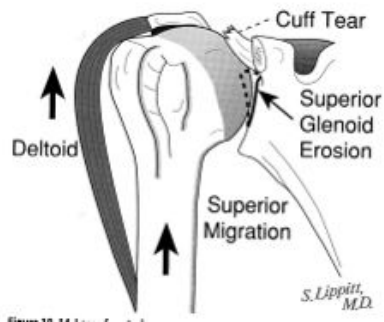
### LES CONTRAINTES



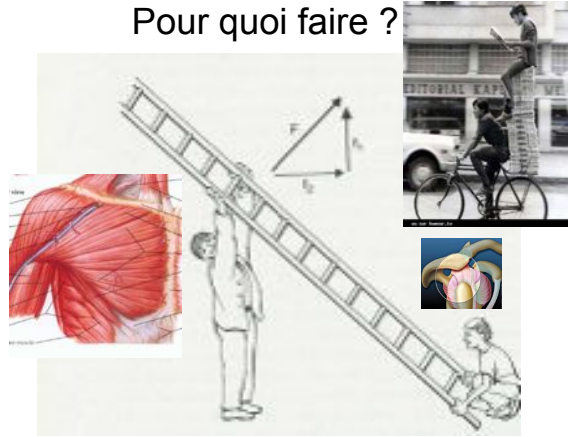
### LES CONTRAINTES

- 90° abd: R = 1x pds du corps
- Avec 5 kgs: R = 2,5 pds du corps
- Comparable à celles observées dans une hanche, avec une surface de contact inférieure!!



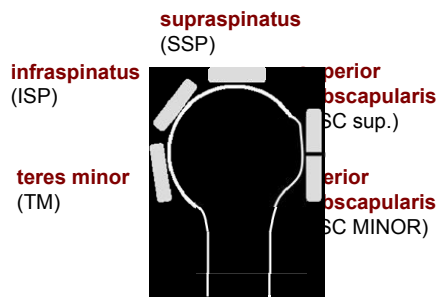


Pour quoi faire ?



## Compartments of the rotator cuff

we divided the rotator cuff as 5 compartments

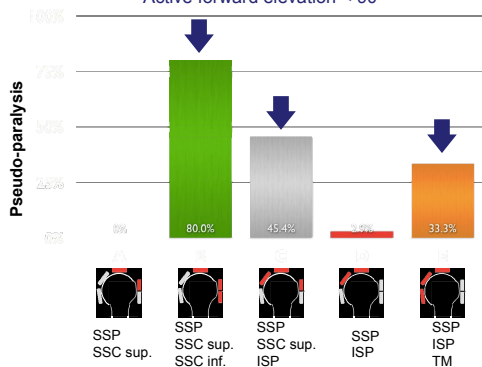


## Active forward elevation



## Pseudo-paralytic shoulder

Active forward elevation < 90°



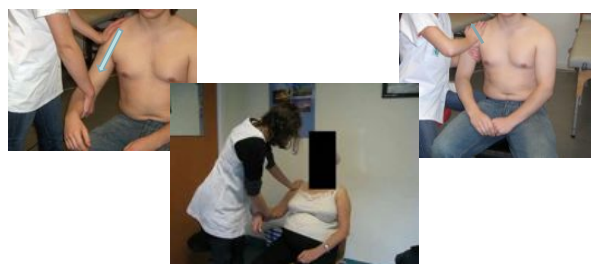
## Objectif 2 :

Recentrer la tête humérale  
Améliorer la cinématique scapulo-humérale

Technique de recentrage (R.SOHIER, T.MARC)

Correction du décentrage supérieur

Correction du décentrage antérieur



### **Objectif 3:**

#### **Solliciter les muscles stabilisateurs et mobilisateurs de la scapulo-thoracique**

**Bon placement de la glène, ouverture de l'espace sous-acromial**

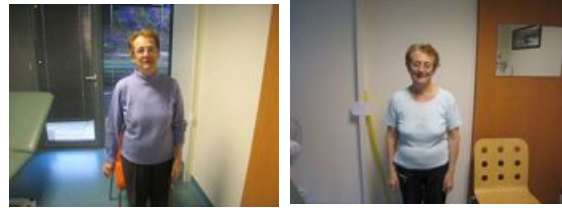
**Correction de la bascule antérieure de la scapula**



**Stabilisation de la scapula et orientation de la glène**



Solenn GAÏF  
Unité d'épaule  
CHP Saint-Grégoire (35)



## **CONCLUSION**

- Succession de maillons articulaires qui fonctionnent simultanément, dont l'intégrité est nécessaire à la qualité de la fonction
- Système de force et mécanique de précision, solide et fragile