ARTHROSCOPIC ROTATOR CUFF REPAIR
BASIC GUIDELINES

Function of RC

(Slide 2) The function of RC is * primarily to stabilize and centralize the humeral head to the glenoid. * This is achieved by balancing the force couples in the coronal and transverse plane. .
(Slide 3) The coronal plane force couple consist of the moments created by the * deltoid, superiorly, versus the moments created * by the inferior RC (ie Infraspinatus, teres minor, Subscabularis).
* This force couple is balanced as long as the RC force is below the centre of rotation of the humeral head. This means intact inferior RC.

In the transverse plane, (slide 4) the force couple consists of the
* Subscapularis anteriorly, * against the posterior RC (ie Infraspinatus, teres minor)

* Therefore, (slide 5) when we are faced with RC tears, where an anatomical repair is not possible, * the primary goal of surgery is to balance the force couples in the coronal and transverse plane and not necessarily to cover the hole

Functional tears

Admittedly there are tears like this * (slide 6) which are symptomatic and tears * like this which are asymptomatic.

Stephen Burkart described * the ' cable ' of the RC. (Slide 7) This is a cable like structure consisting of a thickening of the coracohumeral lig located in the avascular zone of the RC.
It extends from the anterior attachment of the RC, along the whole distance to the posterior attachment of the RC.
* This is an arthroscopic view of the Rotator cable.

The Rotator cable serves * to absorb the stresses during motion and so to relieve the weak avascular zone from stresses.

(Slide 8) This is an analogous model of a load-bearing suspension bridge.

*This model would predict that,(Slide 9) despite a tear in the avascular zone, the RC could still exert compressive effect on glenohumeral joint as long as the rotator cable is intact, by distributing loads along this cable.

* This hypothesis has been proved by in vitro experiments of Halder et al. in 2002.
* This is the explanation why certain RC-tears , we call them
‘ Functional tears’ even when massive ,can demonstrate
‘ normal’ kinematic pattern.
And also why we achieved good results after RC- repair even when a water-tight closure is not achieved.

Experience of RC- Repairs

(Slide 10) What have we learned from RC- Repair through the years?

(Slide 11) Prof Ken Yamaguchi, Washington University School of Medicine, studied the natural history of * **asymptomatic tears** and demonstrated the following:

a. 51% of them became symptomatic in avg of 2.8 years.
b. 50% of the tears showed progression in size and retraction
c. Non of the tears showed healing.

He also demonstrated (Slide 12) that * the **delay** of repair may cause:

1. Extension of the tear with retraction and development of adhesions
2. Muscle atrophy and fatty degeneration, a negative prognostic factor for healing
3. Degenerative changes and altered kinematics of the shoulder joint.

In conclusion, (Slide 13) we can anticipate * as negative prognostic factors for RC-Repair the following:

1. The **delay** between the initial presentation of symptoms and time of operation
2. The degree of **retraction** (which is also time dependent)
3. The Presence of **delamination** and **fatty degeneration**
4. As well as the **age** of the patient

In other words (Slide 14) the * Early treatment of RC-Tears provides:

1 Long term pain relief of all patients
2 The best potential of healing especially in young patients and small tears
3 Excellent function of RC and
4 Prevention of the development of chronic degenerative changes.

(Slide 15) Arthroscopic RC- Repair is a technically demanding procedure * and has a steep learning curve.

It requires* special surgical skill, good training , good organization in operating theatre and investment of time at the beginning.

(Slide 16) **A stable construct?**

(A stable Construct between the tendon and the bone consist * of the initial stable mechanical fixation, * which needs a good surgical technique, and* the biological factors.
Favourable issues concerning **biological factors**, now days are:
a. the patient's age (the younger the patient the better results)
b. The size of the tear as well as the quality of the torn tendon
c. Non smoking patients
d. For the time being there are current studies investigating the use of growth factors and some other studies investigating the acromioplasty as a tool of releasing growth factors.

Initial Mechanical Fixation

(Slide 17) Concerning **initial mechanical stability** I would like to point out some issues.

1. When using transosseous tunnels, the weak point is the suture being cut through the bone.
2. * By using suture anchors, the weak point is effectively transferred from the bone to the tendon.

   Experiments showed that failure first occurs in the centre of the tendon,

   where the tension is at its maximum so very important point is the * repair to be without any tension. In addition the anchors must be placed in a way of respecting the crescent-shape margin of the tear. Particularly in a single row technique. As we see here , the anchors have been placed in away of respecting the crescent- shaped margin of the tear.

   * Sometimes it is better to medialize our fixation in order to decrease tension, than to repair in the anatomical place under tension.

3. *One simple method of minimizing suture cut out through tendon is to increase the number of fixation points. (Accordingly the load per fixation point is decreased). In other words to use more sutures. * or double row technique.

4. (Slide 18) Another issue is the insertion angle of the anchors. * Well known is the so called dead man angle, which must be less than 45°.

5. Of course the last point is the good surgical technique.

(Slide 19) Good surgical technique means understanding the pathology of the tear pattern and * so offer an optimal repair with initial stable construct, followed by time for healing and rehabilitation.

(Slide 20) This is a picture of Dr Willems and myself taken while I visited him in Holland.
* Arthroscopy has greatly enhanced our understanding of RC-tears. * It provides us the ability to assess the RC from several different angles with minimal disruption of the overlying Deltoid. Arthroscopy has led us to recognize four major types of RC-tears.

Tear Patterns

a. (Slide 21) Crescent –shaped tears
b. U- shaped tears
c. L-shaped , or reverse L- shaped tears
d. Massive contracted immobile tears

1. **(Slide 22) Crescent-shaped tears** are the simplest of all tears. * Usually these tears, although they can be massive, do not retract medially to a significant degree. * They demonstrate excellent mobility from medial-to-lateral direction and * can be repaired directly to bone with minimal tension (anatomic Repair) *These tears are excellent candidates for double row technique.

2. **(Slide 23) U-shaped tears *** extend much further medially than the crescent-shaped tears, their apex reach the glenoid rim or even further medially.
   * They demonstrate decreased medial-to lateral * mobility , * but significant mobility from anterior-to- posterior and the opposite direction.
   * Their recognition is critical, because an attempt to mobilize and repair them to the lateral bone bed would certainly fail.
   * They should be repaired with **Margin Convergence' technique.** This means side –to-side repair of the tendon and then repair of the lateral free edge to the lateral bone .
   The technique of Margin Convergence both allows repair of seemingly irreparable tears, and also minimizes strain at the repair side.

3. **(Slide 24) L-shaped Tears** * have additional to the tear of the tendon from the lateral bone bed, a significant longitudinal splitting along the rotator interval. These tears are recognized by the characteristic

* that the posterior leaf has more mobility from posterior-to- anterior direction than the anterior leaf.

*The longitudinal split is repaired firstly by side-to-side repair ,and then the free edges are repaired to the lateral bone.

4. **(Slide 25) Reverse- L-shaped Tears *** have the longitudinal splitting along the supraspinatus and infraspinatus. * Their anterior leaf demonstrates excellent mobility from anterior-to-posterior direction. They must be repaired in the same way like L-shaped tears.

(Slide 26) **Why is it so important to recognize** the tear pattern ?

Repairing the tear according to its natural mobility * decreases repair tension, * limits tension overload (a common cause of failure of repair), and * improves the results of treatment.

(Slide 27) Steps in RC- Repair

A. **(Slide 28) _ Acromioplasty?** Is it necessary?

* Most of the surgeons perform an acromioplasty * in order to gain more space during the procedure,* to protect the RC repair and * for possible release of growth factors. * **Beware if** the tear is irreparable. In such a case , it is better to avoid ressecting the Coracoacromial lig and perform only smoothening of the acromion.

B (Slide 29) **Assessing the tear mobility**

* This is the key factor in identifying the tear pattern in a complete and accurate assessment of the mobility of the torn tendon before any release.* Assessing the mobility by viewing through several portals.

Slide 30**) 1. Assessing the medial to lateral Mobility**

* While viewing through the posterior portal * a grasper is inserted through the lateral portal and assess the medial –to lateral mobility.

* If the tear is reducible under minimal tension to the lateral aspect of the foot print, the tear is a crescent-shaped tear.

This type of tears can be anatomically repaired.* If the tear is a massive one it is advisable to place traction sutures for better handling.

2 (Slide 31) Anterior to Posterior Mobility

* While viewing from the lateral portal, * a tendon grasper is introduced through the posterior portal and assess the mobility of the anterior leaf in a anterior –to-posterior direction.

Similarly * the mobility of the posterior leaf is assessed by introducing the tendon grasper through the anterior portal.

(Slide 32) If the medial–to-lateral mobility is decreased but
* both leaves demonstrate equal mobility, (in anterior and posterior and in the opposite direction) then the tear represents a U-shaped tear.

(Slide33) U-shaped tear must be repair with Margin Convergence technique * this means initial side-to-side suturing of the anterior and posterior leaves to achieved margin convergence. * And then the free edges of both leaves are directly repaired to the bone.

IF THE ANTERIOR-TO-POSTERIOR Mobility of the two leaves is not equal then the tear is one of the L-shaped or Reverse-L-shaped tear.

*** (Slide 34)** If the Mobility of the posterior leaf is more than the mobility of the anterior leaf, in other words more mobility from posterior to anterior , the tear is an **L-shaped tear.** * This tear is repaired by firstly repair the longitudinal split with side to side repair and then direct repair to bone.

(Slide35) If the mobility of the two leaves is more to posterior direction than anteriorly, then the tear is a **Reverse L-shaped** tear. This tear is repaired in the same way like the L-shaped tears.

IN THESE SITUATIONS IT IS **very important** to determine the corner of the L-shaped tear, the point of the maximum mobility. Different points along the posterior leaf are evaluated for mobility, and the one with the best mobility is chosen for the corner.

* (Slide 36) If the medial to lateral mobility and also the anterior to posterior mobility is decreased, then the tear is a **massive contracted immobile** tear. The treatment of these kinds of tears is the subject of the talk of Dr Di Giacomo, who will follow.

C Foot print Preparation

(Slide 37) The next step is the preparation of the foot print, the bone bed, where the tendon is usually inserted. * This bone bed is cleaned very good and delicately decorticated for bleeding purposes.

(Slide 38 Next step is the debridement of the edges of the torn tendon. * Very gentle debridement of the edges of the torn tendon for refreshing purposes .

(Slide 39) Then we have to think about anchor placement.
* We have to consider how many anchors are going to be used. Generally speaking for every cm of tear in anteroposterior direction one anchor is necessary. * And of course we have to consider if single or double row technique is going to be performed.

*(Slide 40) For single row technique the anchors are placed on or lateral to the great tuberosity,

Slide 41 → Now I would like to present a Video with Repair of a crescent –shaped tear

Slide 42 → This Video shows a Repair of a U- Shaped tear
Slide 43 → This Video presents a Repair of a Reverse L- Shaped Tear

<u>(Slide 44) Double row technique</u> (Few words about Double Row Technique)

* Keeping in mind that the RC- insertion is not a simple linear structure, but rather an area of 7- 14 mm we can easily realise that a single row repair does not restore the normal foot print.
* During abduction the medial aspect of the tendon insertion can lift away from the bone bed.
*A study by Apreleva demonstrates that a single row repair restores only the 67% of the original foot print.
* A double row technique, restores more adequately the foot print. Furthermore, by proving a second row of fixation, the number of fixation points* is increased and therefore less load on each suture.

(Slide 45) For the double row technique the medial row anchors are placed next to the cartilage and all the sutures are passed through the tendon medially and tied.
Then we take the medial sutures and fixed them laterally.

(Slide 46) In this slide we see an arthroscopic picture of a double row technique before the medial row to be tied.
* In this picture we se the different after tying the medial row
This is a view after single row and this is after double row technique.
(Slide 47) → The last video demonstrates a repair with double row – suture bridge technique.

I specially chose this interesting case, where we se the dislocated Biceps due to Subscapularis tear.