EFOST

Surgical Techniques in Sports Medicine

Shoulder Surgery Volume 1:
Instability and Trauma

Francesco Oliva • Howard Cottam

Series Editors François M Kelberine • Nicola Maffulli

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JP medical publishers

London • Panama City • New Delhi

Published by JP Medical Ltd,
83 Victoria Street, London, SW1H 0HW, UK
Tel: +44 (0)20 3170 8910 Fax: +44 (0)20 3008 6180
Email: info@jpmedpub.com Web: www.jpmedpub.com

ISBN: 978-1-909836-55-6

British Library Cataloguing in Publication Data
A catalogue record for this book is available from the British Library

Library of Congress Cataloging in Publication Data
A catalog record for this book is available from the Library of Congress

Commissioning Editor: Steffan Clements
Development Editor: Gavin Smith
Design: Designers Collective Ltd

Foreword

Education is one of the key missions of EFOST, the European Federation of National Associations of Orthopaedic Sport Traumatology. The *Surgical Techniques in Sports Medicine* series is the educational flagship of EFOST, and provides an invaluable supplement to the experience afforded by the international EFOST Travelling Fellowship.

This series of highly illustrated handbooks, each dedicated to a specific anatomical region, is aimed at established surgeons, fellows in orthopaedic sports traumatology and residents in orthopaedics. It comprises much more than the simple scientific evidence behind each procedure. The aim instead is to impart practical knowledge arising from the direct experience of highly skilled surgeons, who describe reliable surgical procedures in a practical, easy-to-follow manner that will be of great value to orthopaedic and sports trauma surgeons alike.

Surgical Techniques in Sports Medicine is the fruit of five years' work by the three immediate past presidents of EFOST and is testament to how far EFOST has come since its foundation in 1992. We hope that you find this book, and the others in the series, a useful resource.

Gernot Felmet
President, EFOST
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March 2017

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2 Arthroscopic labral repair

Indications

- Glenoid labrum tears may occur through any part of the fibrocartilaginous labral ring. Traumatic causes are the most frequent and often affect the anterior or posterior edge of the glenoid, depending on the direction of the trauma
- Microtrauma and tears associated with repetitive sporting injuries may affect the superior labrum and are known as superior labrum anterior posterior (SLAP) lesions and involves the long head of the biceps anchor
- In 1991, Matsen divided the types of shoulder instability into traumatic and atraumatic, referring to traumatic instability by the acronym TUBS (traumatic, unilateral, Bankart lesion, surgery)
- The anatomical damage is due to anterior shoulder dislocation involving soft tissue and bone (the glenoid rim and humeral head)
- The most common defect is antero-inferior capsulolabral complex detachment from the glenoid rim and glenoid neck, which was first described by Arthur Bankart in 1939, and is known as a Bankart lesion
- The Hill–Sachs lesion (also called Hill–Sachs fracture) is the cortical depression of the superior-posterolateral region of humeral head, which occurs as a result of the impact of the head with the edge of anterior-inferior glenoid
- Recurrent instability is common following anterior shoulder dislocations, and the worsening of Bankart and Hill–Sachs lesions is unavoidable. Di Giacomo, Itoi & Burkart (2014) established the indications for arthroscopic Bankart repair as shoulder instability with less than 25% glenoid bone loss and a non-engaging Hill-Sachs lesion. They described the concept of on-track and off-track bone defects. (**Table 2.1**)
- SLAP lesions were described by by Snyder in 1991. They can be categorized into four types (**Figure 2.1**). They are responsible for painful symptoms with subtle instability that reduces the performance of athletes giving the sensation of a detached and weakened shoulder ('dead arm' syndrome)
  - *SLAP type 1 lesions.* these lesions do not need repair: the labrum is not detached but is fibrillating. Simple debridement of the upper labrum is sufficient
  - *SLAP type 2 lesions.* These are the most frequent lesions seen and are characterized by a detachment of the upper labrum from the glenoid, both anteriorly and behind the long head of the biceps. They often need repair.
  - *SLAP type 3 and type 4 lesions.* These often result from a worsening of a type 2 lesion, involving bucket handle tear (type 3); and upper labrum detachment with the tear extending into the long head of the biceps (type 4). In both cases, arthroscopic treatment is required. In type 3 the bucket handle must be removed and the residual labrum repaired; in type 4 the tear is

Table 2.1 Evolving concept of bipolar bone loss and the Hill–Sachs lesion (with permission from Di Giacomo et al. 2014)

Group	Glenoid defect	Hill-Sachs lesion	Treatment
1	<25%	On-track	Arthroscopic Bankart repair
2	<25%	Off-track	Arthroscopic Bankart repair plus remplissage
3	>25%	On-track	Latarjet procedure
4	>25%	Off-track	Latarjet procedure

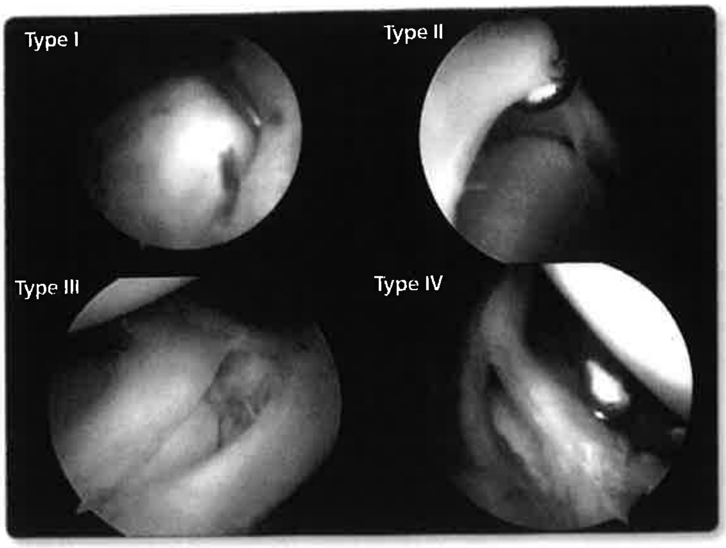

Figure 2.1 SLAP lesions.

debrided with tenotomy and tenodesis of the long head of biceps tendon

Preoperative assessment

Clinical assessment

- *Anamnesis:* presence of a traumatic event and trauma mode, number of episodes, reduction mode, description of the activities of apprehension, functional disability
- *Active and passive range of movement:* complete mobility is usually preserved the patient is often apprehensive in abduction and external rotation
- *Apprehension test:* abduction and external rotation of the arm and the head of the humerus are pushed anteriorly and inferiorly. The test results are positive if pain or apprehension is present
- *Relocation test:* following a positive apprehension test, apply anterior pressure over the glenohumeral joint. The test result is positive if pain or apprehension disappears
- *Drawer test:* the examiner stabilizes the scapula with one hand and moves the head of the humerus anteriorly and posteriorly with the other. Excessive anterior or posterior translation indicates laxity of the glenohumeral joint
- *Jerk test:* the examiner stabilizes the scapula with one hand and holding the elbow with the other hand pushes the elbow posteriorly, adducting the arm. Pain, anxiety or the sensation of a 'click' indicate posterior instability
- *Sulcus test:* the examiner holds the forearm below the level of the elbow and pulls downwards. If a depression under the acromion is created, the test is positive for more subtle instability
- *O'Brien's test:* the patient should raise the arm against resistance, with the forearm extended and pronated. The O'Brien's test is positive if the procedure causes pain in the biceps
- *Mimori test:* the arm is abducted at 90°, externally rotated upwards and with the elbow flexed to 90°. The forearm is then pronated and supinated. The test is positive for micro-instability of the shoulder if the pain is greatest during pronation
- *Palm up:* the patient should elevate the arm against resistance, with the forearm extended and supinated. If it causes pain in the biceps, the test is positive

Imaging assessment

Radiographs

- Radiographs show the correct reduction of shoulder dislocation and help to exclude any fractures associated with the dislocation (**Figure 2.2**)
- A Bernageau view should be used to assess the bone defect (**Figure 2.3**)

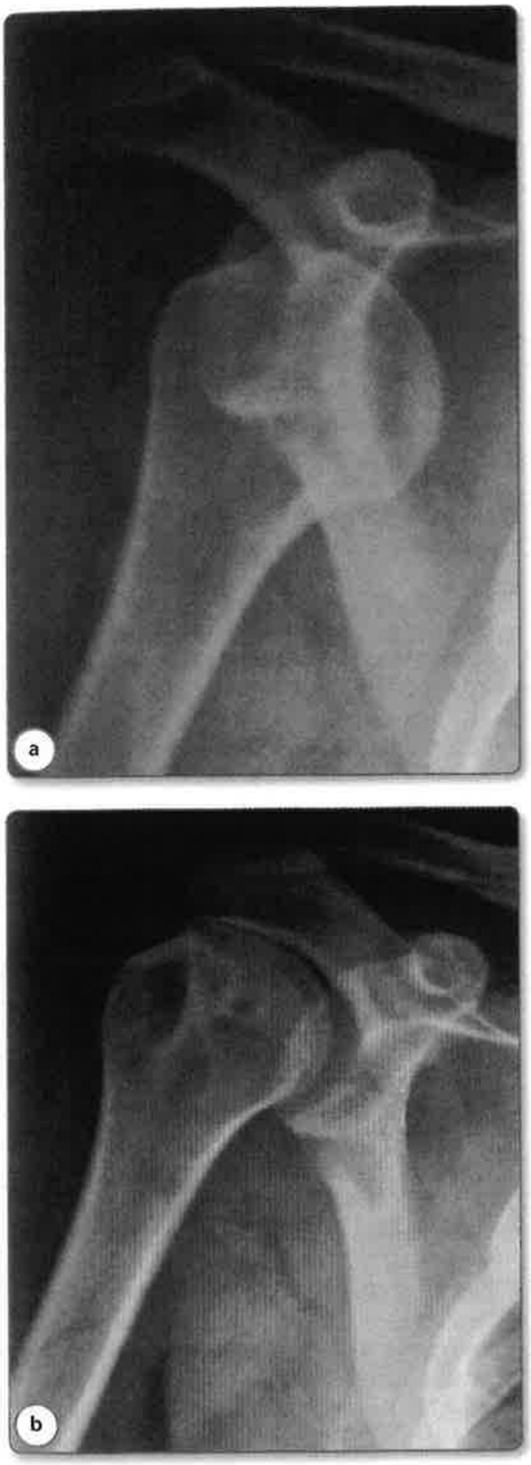

Figure 2.2 (a) Anterior shoulder dislocation. (b) Control after reduction.

Magnetic resonance imaging (MRI)

- MRI can identify associated pathology (e.g. Hill–Sachs and Bankart lesions) with detachment of the antero-inferior glenoid labrum and laxity of the middle glenohumeral ligament and inferior glenohumeral ligament (**Figure 2.4**)
- Detachment of the posterior labrum looks similar to an anterior labrum tear on MRI but involves the equatorial or higher glenoid rim. It is often a simple longitudinal tear (Kim lesion), but less frequently a reverse Bankart with reverse Hill–Sachs lesion can be identified on the anterior part of humeral head (also known as a McLaughlin lesion)
- The sensitivity of MRI to identify SLAP lesions is low
- *Artro-MRI:* shows capsular overflow and allows a higher definition of anatomical lesions (**Figure 2.5**). It is the gold standard procedure in cases of instability and especially when a SLAP lesion is suspected

Computed tomography (CT)

- The PICO method and 3D reconstruction of the shoulder is used to study the glenoid track and identify bone defects (**Figure 2.6**)

Figure 2.3 Bernageau view.

Figure 2.4 Magnetic resonance imaging (MRI) in shoulder instability.

Figure 2.5 Arthro-MRI in shoulder instability.

Timing for surgery

- Anterior or posterior instability with apprehension and a reduction in functional capacity represents an indication for surgical treatment

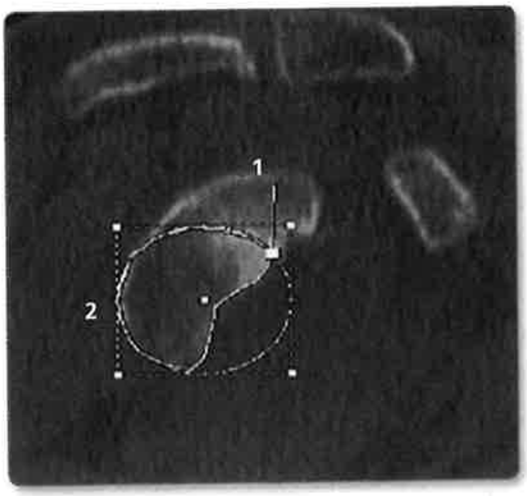

Figure 2.6 PICO method is used to study the glenoid bone defect.

- In a first dislocation, a Bankart repair is indicated in patients under 20 years old, who are the age group who present with the highest rate of redislocation after a first episode
- The standard indication is recurrent dislocation (2nd episode) that is not age related
- A first dislocation in high performance athletes is an absolute surgical indication for arthroscopic Bankart repair
- Pain and discomfort with a 'dead arm' syndrome are the conditions which indicate repair of an isolated SLAP lesion

Surgical preparation

Surgical equipment

- Arthroscopic devices and standard instruments for shoulder arthroscopy, and specific arthroscopic instruments for shoulder instability (spectrum hooks, direct sutures retriever graspers, shuttle sutures, anchors) (**Figure 2.7**)
- Non-metallic anchors have been shown to be comparable to metallic anchors, and are advised by the author
- Bioabsorbable anchors should not be used because they can cause serious problems, including high bone resorption and glenoid defects

Equipment positioning

- The surgeon should be positioned behind rather than lateral to the shoulder of the patient, with the arthroscopic tower opposite and the second surgeon positioned from anterior to lateral

Patient positioning

- *Lateral:* double traction (3–5 kg) arm abduction at 70° and arm anteposition at 20°. A pillow under the axilla is often necessary for improved distraction of the humeral head
- *Beach chair:* arm abduction at 70°, back, hip and knee flexed to 90° and the upper arm positioned on the shoulder distractor (**Figure 2.8**)

Surgical technique

Skin marking

- It is **good practice** to mark the anatomical landmarks prior to surgery (**Figure 2.9**)
- It is important to mark all possible arthroscopic portals

Arthroscopic portals

- *Posterior portal:* classic soft spot is 2 cm medially and 2–3 cm inferiorly
- *Matthews antero-inferior portal* in the safe triangle (superior edge of subscapularis tendon, inferior edge of long-head of biceps and supero-anterior glenoid rim)
- *Antero-superior portal:* 2 cm medial from the anterior angle of the acromion
- *Wilminghton portal:* 3 cm distal and 2 cm anterior from posterior angle of acromion
- *Nevaiser portal:* 1 cm medial border in the acromion – soft top spot
- The three most useful standard portals for simple labrum repair are:
  1. Soft spot
  2. Antero-inferior portal (AI)
  3. Anterosuperior portal (AS)
- Screwed cannulas are important as disposable devices to maintain an open, secure and effective portal during the repair
- Three cannulas should be used: one 8 mm cannula in the AI portal, one 5 mm in the AS portal and one 8 mm cannula in the soft spot
- In the case of SLAP lesions, the Wilmington portal should be used for a better angulation of the anchors with respect to the upper glenoid,

Figure 2.7 Arthroscopic tower.

Figure 2.8 (a) Beach chair positioning. (b) Shoulder distractor.

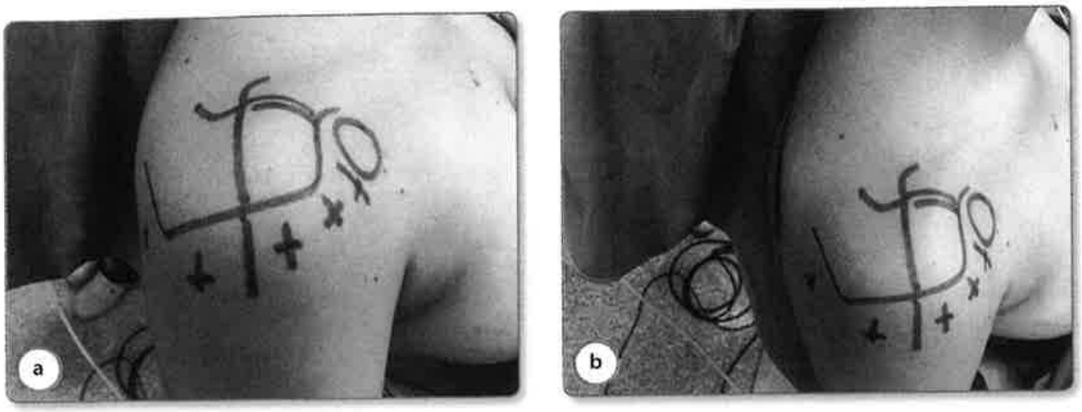

Figure 2.9 Skin marking and portals.

and the Neviser portal is ideal for the direct passage of the sutures in the labrum with a grasper for direct suture passage. In the repair of the posterior labrum, the Wilmington portal is required to plant anchors at the correct angle

Recognition of the lesion and planning the repair

- The extent of the lesion on the glenoid rim should be defined to gauge the number of anchors and sutures required. The defect should be described as if looking at a clock face (**Figure 2.10**)
- Associated lesions should also be identified. A SLAP tear is often present, but cuff tears are not common and are usually only present after many redislocation episodes. There is a strong correlation between a rising number of dislocations and associated lesions of the supraspinatus and infraspinatus. This correlation becomes stronger after seven episodes of dislocation
- The number of anchors, sutures and the repair time should be planned, to achieve a methodical and effective repair (**Figure 2.11**). The SLAP lesion will be repaired at the end of the labral suture to prevent excessive tension of the labrum and restricted workspace (**Figure 2.12**)

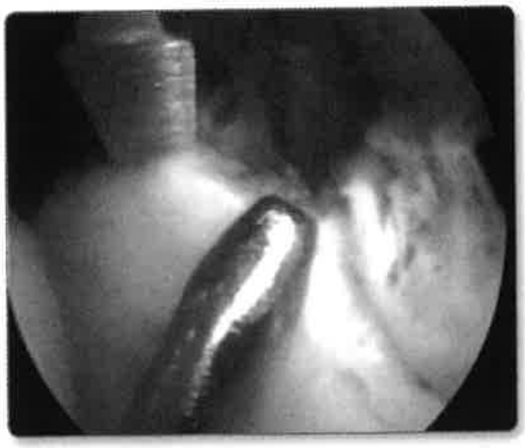

Figure 2.10 The lesion extension identification from antero-superior portal with a scissor in the antero-inferior portal and a Wissinger rod from the posterior portal.

Detachment of the labrum

- In anterior lesions the tissue from the glenoid is separated until , the subscapularis muscle can be seen (**Figure 2.13a,b**). Glenoid reaming to bleed the bone of the neck increases the healing process (**Figure 2.13c**)
- The glenoid labrum is mobilized anteriorly or posteriorly to ease repair, especially if it is cicatrized medially as in an anterior labroligamentous periosteal sleeve avulsion (ALPSA) lesion
- In SLAP lesions, the superior labrum should be mobilized and the glenoid neck debrided with synovial aggressive blades or with a gentle burr. The arc of the SLAP lesion and its extension, especially posteriorly, should be defined

Figure 2.11 Left shoulder: view from the posterior soft spot. Using the radiofrequency instrument inserted through the anterior portal, mark the proposed anchor positions.

Figure 2.12 Right shoulder-associated SLAP lesion visualized from soft spot, probe in the AS portal.

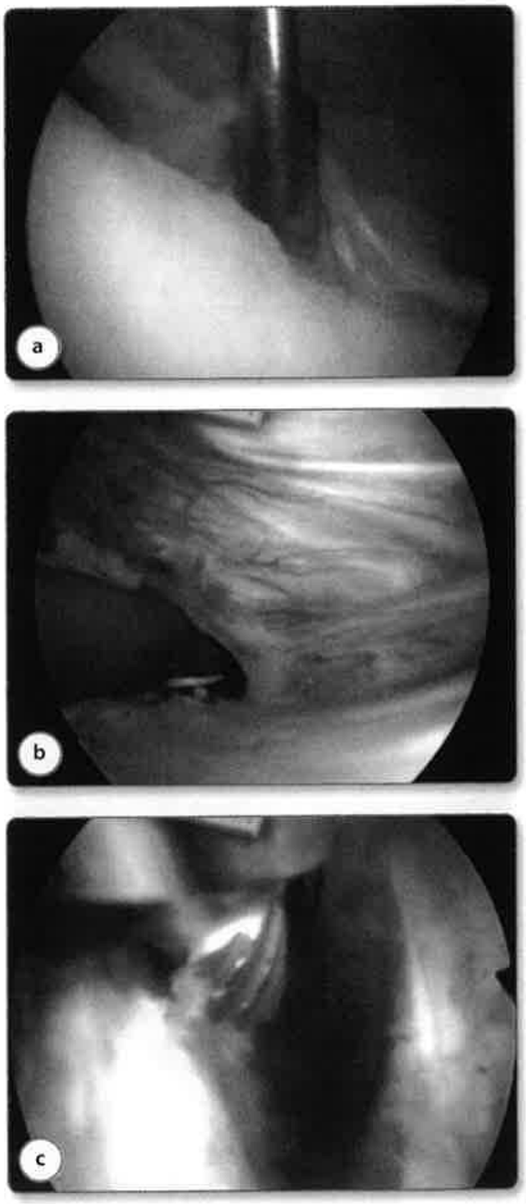

Figure 2.13 (a, b) Left shoulder: view from the posterior soft spot. Separation of tissue from the glenoid, using scissors and radiofrequency instrument inserted from the anterosuperior portal. (c) Glenoid reaming with Burr inserted from the anterior portal.

Positioning of the anchors

- An insertion angle of 45° is maintained to ensure secure anchor position in the glenoid, or avoid damage to the glenoid (**Figure 2.14a**). Double loaded anchors should be used (**Figure 2.14b**)
- An effective position (5 o'clock and 3 o'clock on right anterior glenoid rim) should be chosen. In a SLAP lesion repair through the Wilmington portal, the optimal position of the anchors needs to be chosen: one anchor with two sutures should be placed at 12 o'clock under the long head o the beceps tendon (LHBT) to facilitate the passage of the suture, one posteriorly and the second anteriorly to the LHBT (**Figure 2.15**). In the case of a SLAP lesion with posterior extension, two anchors will be useful: the first at 11 o'clock and the

second at 12 o'clock to cover the whole lesion, being careful to avoid overtensioning the biceps anchor
- A pull-out test should be performed to ensure anchor security

Suture of the labrum

- *Bleeding soft tissues:* a full radius dissector is used to gently abrade the capsule (**Figure 2.16**)
- The capsule is plicated proximally towards the glenoid, reducing the inferior capsule enlargement by transferring the arthroscope to the anterosuperior portal and using the hook from the posterior portal. Plicate the inferior glenohumeral ligaments (IGHL) at 6 o'clock to the first anchor (**Figure 2.17**)
- In the case of a SLAP lesion, particularly if isolated, the superior glenohumeral ligaments (SGHL) should be gently plicated with the anterior wire of a two-suture loaded soft anchor and the Nevaiser portal used to directly pass the sutures through the posterior superior labrum. If the extension of the tear is more than 10 mm, the soft spot should be used for direct suture management through the labrum to allow better positioning of the instruments

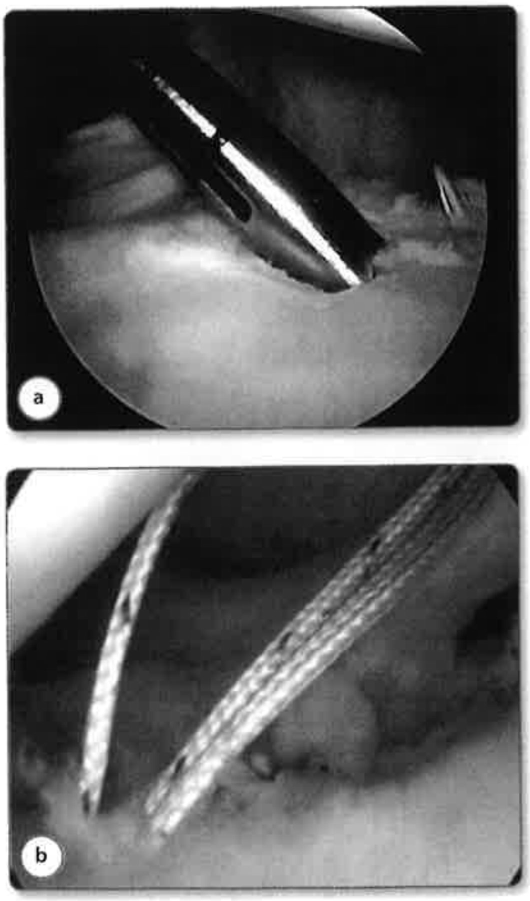

Figure 2.14 (a) Left shoulder: view from the soft spot. Cannula for the insertion of the soft anchor inserted at an angle of 45°. (b) Left shoulder: view from the soft spot. Double suture anchor.

Figure 2.15 Right shoulder: view from the soft spot. One anchor at 12 o'clock with two sutures, the first posterior and the second anterior to the LHBT.

Figure 2.16 Left shoulder: view from the soft spot. Radius dissector inserted from the AS portal that gently abrades the capsule.

- The suture is shuttled through the soft tissue with a strong non-absorbable wire. It is important to keep the sutures in sight so as not to confuse the wires, tangle them and lose the anchor (**Figure 2.18**). Direct retrievers or graspers, such as BirdBeak (Arthrex), can be useful if the direction of repair allows
- The IGHL and middle glenohumeral ligaments (MGHL) are retensioned from the posterior, with a 'crossing stitch' (**Figure 2.19**)

Completion of knots

- Knot security: seven half stitches and sliding knots (**Figure 2.20**)
- 'Bumper effect' (**Figure 2.21**)

Checking the repair

- The stability of the sutures is evaluated with a probe, and the effectiveness of the surgery is evaluated through the restoration of the centering of the head in the glenoid fossa (**Figure 2.22**)

Possible perioperative complications

- These are often due to errors in surgical technique. The suprascapular nerve, which is located approximately 2 cm from the back edge of the glenoid, can be damaged by

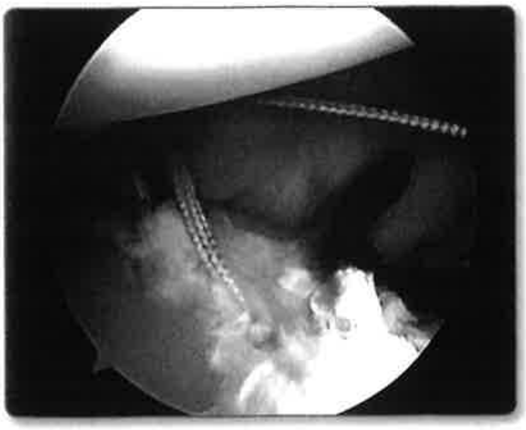

Figure 2.17 Left shoulder: view from the soft spot. Plication of IGHL at 6 o'clock to the first anchor with the hook arthroscopically inserted from the AI portal.

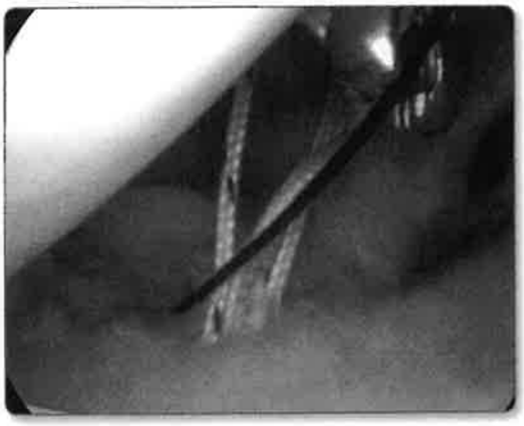

Figure 2.18 Left shoulder: view from the soft spot. Non-absorbable wire used to pass suture through the soft tissues from posterior portal.

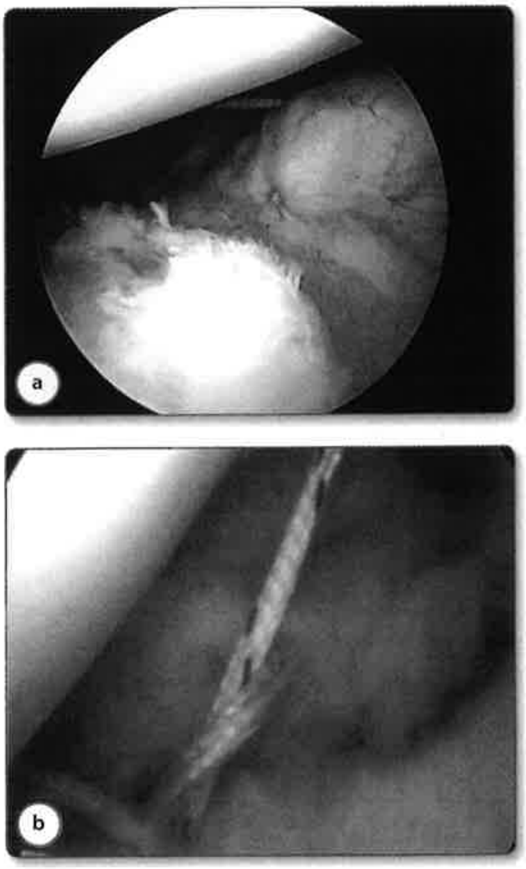

Figure 2.19 Left shoulder: view from the soft spot. (a) Retensioning of the MGHL. (b) 'Crossing stitch' from posterior portal.

Figure 2.20 Left shoulder: view from the soft spot. Sliding knots from the posterior portal.

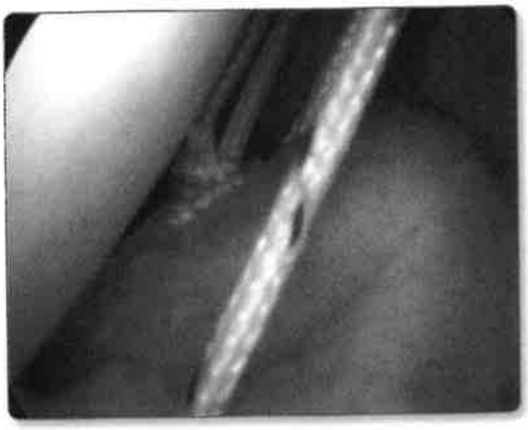

Figure 2.21 Left shoulder: view from the soft spot. Capsule and labrum that create the "Bumper effect".

misguided handling of the rear portal. 'Wiper movements' should be avoided during the execution of the soft spot
- Errors in the insertion of the anchors may cause glenoid edge fractures, chondral injury or mobilization of the anchors

Closure

- No drainage is needed
- Arthroscopic portals should be sutured

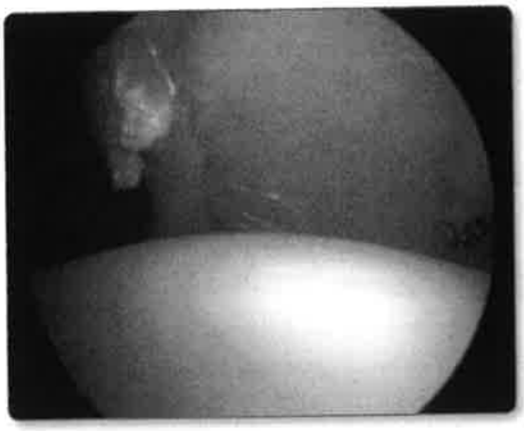

Figure 2.22 Left shoulder. Restoration of the centering of the head in the glenoid fossa viewed from the lateral portal.

Postoperative management

Postoperative regimen

- The doses of painkillers, non-steroidal anti-inflammatories, and other drugs should be adjusted accordingly
- Antibiotics should be used until the third postoperative day

Rehabilitation

- A brace should be used for 4 weeks (3 weeks for SLAP lesions) to prevent stiffness
- The brace should occasionally be removed to mobilize the elbow and wrist
- 4–8 weeks postoperatively, re-education should begin to achieve a gradual recovery of the full range of passive and active motion, alongside physical therapy to control muscle contracture and pain, proprioceptive exercises, kinetic and isometric exercises
- 8–12 weeks postoperatively, muscle strengthening exercises with progressive resistance and pain-free pleiomorphic exercises should begin
- 12–16 weeks postoperatively, a gradual return to full activity and sport reconditioning can begin
- 20 weeks postoperatively, a return to contact sport can be made

Outpatient follow-up

- Surgical wound medication should take place every 4 days
- Sutures can be on the 14th day postoperatively
- Clinical monitoring should be undertaken every 2 weeks to assess the progressive recovery of functionality

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10 Reverse total shoulder arthroplasty after proximal humeral fracture

Indications

- Fractures of the proximal humerus are the third most common fractures in those >65 years
- Four-part fractures represent 2–10% of all proximal humerus fractures
- Treatment with open reduction and osteosynthesis performed with plate and screws (ORIF), or humeral head replacement with hemiarthroplasty (HA) often fails (ORIF failure rate is 20%)
- These frequent complications lead to severe functional deficit due to a high rate of failure of the rotator cuff and healing of the tuberosities, which requires revision surgery
- Conversion to a reverse total shoulder arthroplasty allows the patient to recover self-sufficiency in activities of daily living, but can expose patients over 70 years of age to additional surgery and high surgical risks
- In patients older than 70 years with rotator cuff deficit and a high risk of avascular necrosis of the humeral head, reverse total shoulder arthroplasty (RTSA) is indicated as first surgery after proximal humerus complex fractures
- The implant used in RTSA does not need a working cuff, only the teres minor, to ensure external rotation. As it does not stress the tuberosities, these do not resorb but, when well reconstructed, will consolidate
- The reverse shoulder prosthesis is made up of a baseplate and glenosphere constructed on the glenoid side with a humeral cup and stem on the humerus. This is a semi-constrained device that relies on the tension of the deltoid for mobility and stability
- There are two current design methodologies (**Figure 10.1**):
  - The first is based on the original Grammont-style prosthesis, with a medialized center of rotation at the baseplate–glenoid interface. This design moves the humeral shaft inferiorly, complicating cuff repair and reducing tension within the rotator cuff
  - The second design places the center of rotation medially but pushes the humerus laterally by increasing the humeral neck-shaft angle. This design can reproduce a more anatomical position of the humerus, restoring cuff tension and increasing the deltoid wrapping that can enhance stability, strength and mobility, thus reducing glenoid notching
- Despite the differing biomechanics, both prostheses allow for a greater deltoid lever arm, which enables arm elevation in the absence of a functioning rotator cuff. Nevertheless, the most important result is stability of the prosthesis after surgery
- The lateralized design should be more stable after reverse shoulder replacement in proximal humerus fractures

Preoperative assessment

Clinical assessment

- Older patients usually report an accidental fall with trauma to the shoulder, with a medical history of osteoporosis
- The premorbid level of function and occupational level, hand dominance and the ability to participate in a structured rehabilitation program should all be assessed

Clinical evaluation

- Pain and functional inability: mannequin sign with a hematoma that appears on the arm and in the lateral region of the thorax after proximal humerus fracture
- A neurovascular preoperative assessment should also be performed and should include evaluation of the axillary nerve, brachial plexus and axillary artery in both shoulders

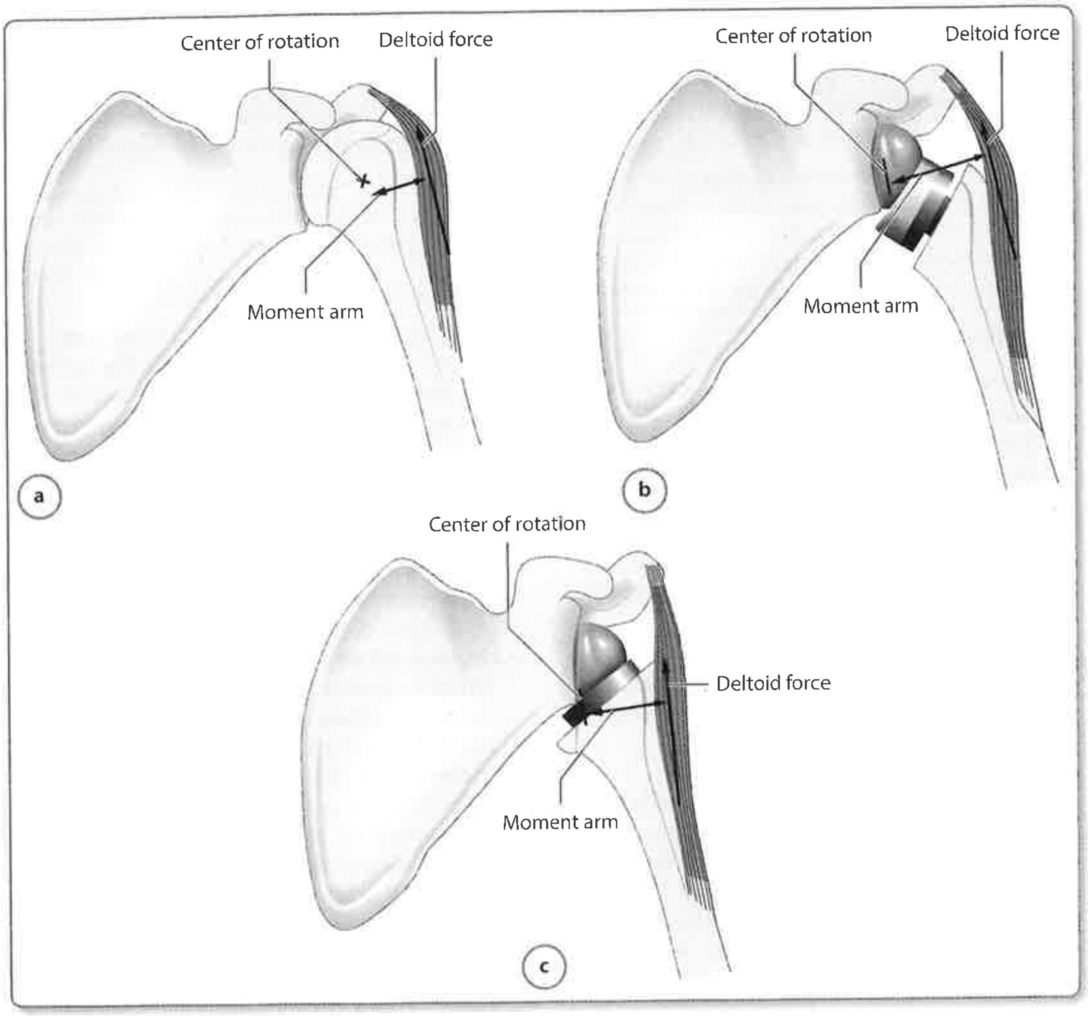

Figure 10.1 RTSA design. (a) Normal shoulder. (b) Lateralized design. (c) Grammont design.

Imaging assessment

Radiographs

- In the emergency department, standard shoulder radiographs must be performed
- Shoulder trauma series should include (**Figure 10.2**):
  - True anteroposterior scapular view
  - Axillary lateral view
  - Scapular Y lateral view

Computed tomography (CT)

- A CT scan with three-dimensional reconstruction must be performed to accurately study the pathological anatomy of the fracture, the integrity of the tuberosity and morphology of the glenoid (**Figure 10.3**)

Magnetic resonance imaging (MRI)

- MRI is helpful to understand the quality of the soft tissue, the integrity of the rotator cuff and the grade of atrophy if present (**Figure 10.4**)

Surgical preparation

Surgical equipment

- Shoulder surgery kit, including appropriate retractors, Hohmann levers, Fukuda lever and Gelpi retractor

- Reverse shoulder instrumentation, according to the specific arthroplasty model, reamers, tappers, connectors, test prosthetic implants
- Fracture stem with lateral and medial fins and suture holes for fixing the tuberosities
- Glenoid baseplate and screws
- Glenospheres
- Humeral trays
- Humeral bearings

Equipment positioning

- Three surgeons are positioned to the front, side and rear of the shoulder

Patient positioning

- Beach chair, with the back, hip and knee flexed at 70°, 90° and 60° respectively (**Figure 10.5**)

Surgical technique

Exposure: deltopectoral approach

- Make an incision that begins from the coracoid apophysis and continues along the deltoid pectoral sulcus, taking care to identify and

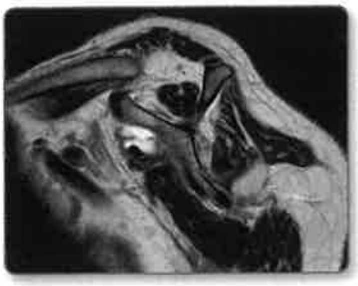

Figure 10.4 MRI evaluation of supraspinatus and infraspinatus muscle quality evaluated in according to Goutallier classification.

Figure 10.2 Radiograph of proximal humeral fracture.

Figure 10.5 Beach chair positioning.

Figure 10.3 CT scan of proximal humeral fracture. (a) The transverse cut is ideal for studying the morphology of the glenoid. (b, c) 3D reconstruction.

isolate the cephalic vein (**Figure 10.6**)

- The cephalic vein must be identified, isolated, and retracted laterally (**Figure 10.7**)
- If additional exposure is necessary, the proximal 1 cm of the pectoralis major expansion and insertion should be released

Identification of fragments

- Identify humerus epiphysis fragments and the rotator cuff tendon (**Figure 10.8**)

Figure 10.6 Skin incision beginning proximally from the coracoid apophysis and continuing along the deltopectoral sulcus.

- If present, identify the long head of the biceps tendon (LHBT) as it passes in the bicipital groove towards the rotator interval, where it serves as a key landmark when re-establishing the anatomic relationship between the greater and lesser tuberosities (**Figure 10.9**)
- Perform tenotomy and soft tissue tenodesis of the LHBT to the pectoralis major tendon with sutures
- If present, remove the superior cuff from the greater tuberosity, preserving the posterior aspect of the infraspinatus and teres minor for good residual external rotation
- Release the rotator interval and coracohumeral ligament to allow mobilization of the tuberosities
- Identify the tuberosities and and place stay sutures: non-absorbable high resistance traction sutures are placed through the rotator cuff insertions on the tuberosities, two or three through the subscapularis and supraspinatus (**Figure 10.10**)
- Remove the humeral head (**Figure 10.11**)

Preparation of the humerus and the implant trial stem

- After identification of the residual humeral shaft, bicipital sulcus and calcar line, the humeral canal can be prepared. The residual calcar is an important landmark to locate the medial superior edge of the humeral stem that must fit together with a proper offset (**Figure 10.12**)

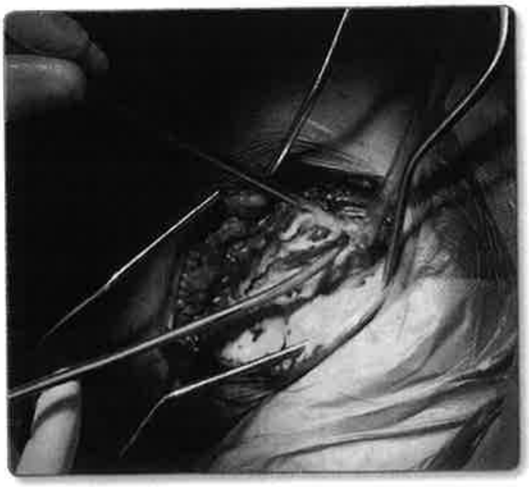

Figure 10.7 After identification of the cephalic vein, access continues medially.

Figure 10.8 Proximal humeral epiphysis fragment identification.

Figure 10.9 Identification of bicipital groove and separation of greater and lesser tuberosities.

Figure 10.10 A high-strength stay suture is inserted into the subscapularis tendon.

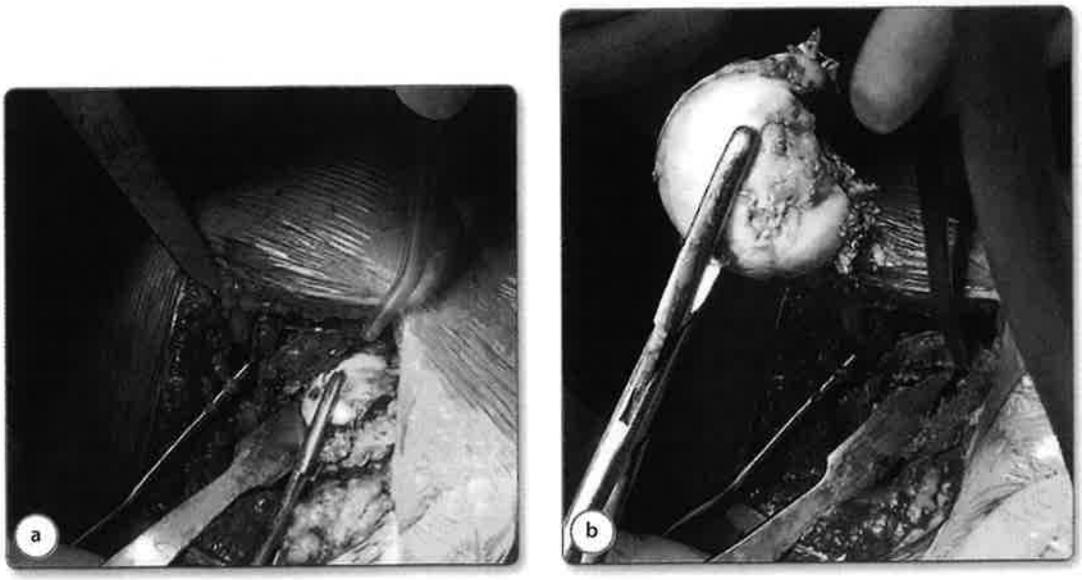

Figure 10.11 Removal of the humeral head.

- Prepare the humerus progressively using reamers of increasing size (**Figure 10.13**)
- The authors prefer to determine the correct height of the prosthesis stem by maintaining the continuation of the calcar line, which is a simple and fast method
- Alternatively, evaluating the distance from the pectoralis major tendon from the shaft – head interface (**Figure 10.14**) (average 5.6 cm [± 0.5 cm]) may provide a useful landmark in restoring humeral length (confidence level 95%). There is no correlation with the patient size
- Position the trial humeral stem. Correct humeral retroversion is critical when recreating the glenohumeral articulation

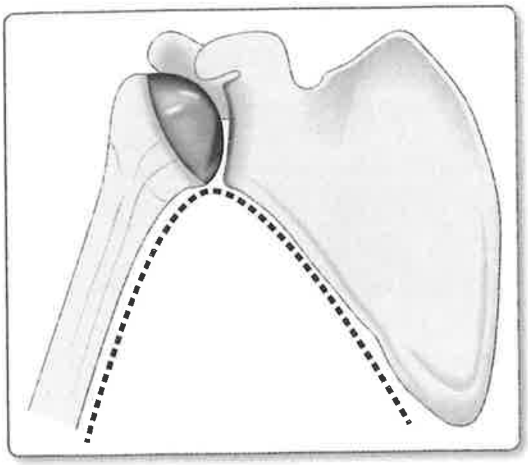

Figure 10.12 Calcar line and correct offset of the humeral stem.

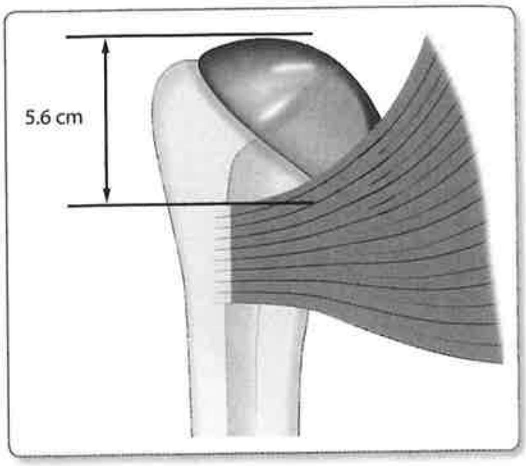

Figure 10.14 Distance of the humeral head from the insertion of the pectoralis major is 5.6 cm.

Figure 10.13 Humeral shaft preparation with reamers of increasing size.

Figure 10.15 Implantation of humeral trial stem with 20° of retroversion.

- Most techniques suggest using the 30° retroversion guide, although native retroversion varies from 10–50° degrees. The authors use a 20° guide (**Figure 10.15**)

Exposure of the glenoid

- The exposure of the glenoid can be performed by exposing it through the tuberosity's 'open book' shape (**Figure 10.16**)
- Remove the superior cuff if present
- The correct morphology of the glenoid must be evaluated and eventually corrected by bone grafts or a baseplate equipped with an augmented metal wedge
- It is important to maintain a retroversion of the glenoid <10° to avoid early loosening of the glenoid component
- The glenoid is then prepared to accept the metal base-plate. The base-plate is held

with screws, which may be compression or locking screws, or a combination of both (**Figure 10.17**)

- At this point, insert trial components, ensuring the optimal offset has been achieved, before deciding upon the definitive component sizes (**Figure 10.18**)

Implantation of definitive components

- Implant the glenosphere in accordance with the chosen offset (lateralized - eccentric) (**Figure 10.19**)
- Implant the definitive humeral stem and reverse components (**Figure 10.20**)
- Cemented or non-cemented implant stem can be chosen according to the bone stock of the case being treated
- To evaluate the stability and final humeral side offset, a trial plastic insert is selected
- Insert the final plastic insert components, reduce the prosthesis and perform a final stability test (**Figure 10.21**)

Fixation of the tuberosities

- The authors use a combination of horizontal, vertical and circumferential sutures to re-attach the tuberosities (**Figure 10.22**). The appropriate number of sutures is seven: four horizontal (in the tendons), two vertical and one circumferential around the stem
- For the greater tuberosity, insert sutures through the tendon and tuberosities to the humeral shaft and fins on the prosthesis if available (**Figure 10.23**). To fix the greater tuberosity, two horizontal sutures have to be passed through the teres minor tendon and

Figure 10.17 Implanting of glenoid base-plate.

Figure 10.16 Exposure of the glenoid.

Figure 10.18 Testing joint stability with trial components.

Figure 10.19 Implanting of the definitive glenosphere.

Figure 10.20 Implanting of the definitive humeral stem and reverse plastic insert.

the stem holes. One vertical suture has to be inserted in the humeral shaft and through the teres minor tendon. The tuberosity will be reduced securely if this is done correctly

- To fix the lesser tuberosity, two horizontal sutures have to be passed through the

Figure 10.21 Final stability test with definitive components.

subscapularis tendon and the stem holes. Another vertical suture has to be inserted in the humeral shaft and through sub-scapularis tendon into the fins on the prosthesis if available (**Figure 10.24**)

- A cerclage suture can be sited from the infraspinatus to the subscapularis tendons, through the prosthesis fins if possible (**Figure 10.25**)
- When tuberosity fixation is completed assess the stability of the tuberosities (**Figure 10.26**)

Possible perioperative complications

- Glenoid fractures
- Humeral shaft fractures
- Implant instability
- Bleeding of the cephalic vein

Closure

- It is not necessary to suture the rotator interval
- The deltopectoral interval is usually closed with nonabsorbable sutures

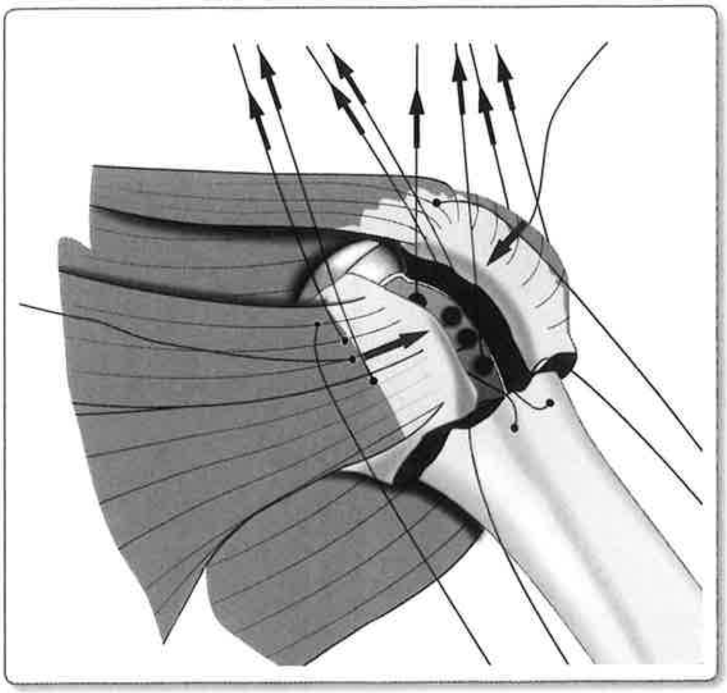

Figure 10.22 Passing of the suture scheme.

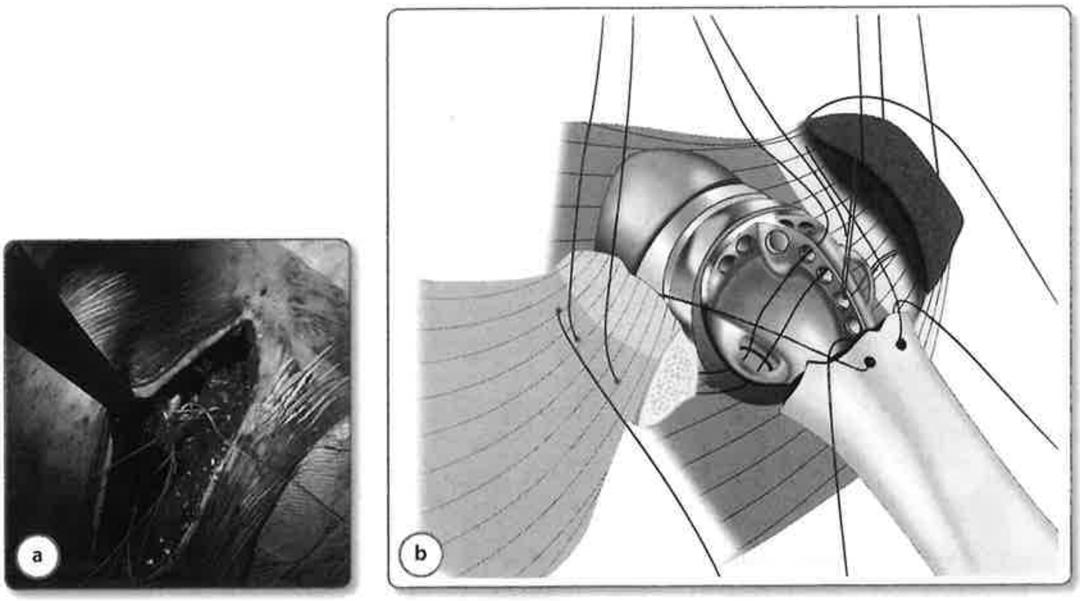

Figure 10.23 (a, b) Longitudinal passage of sutures to close the greater tuberosity.

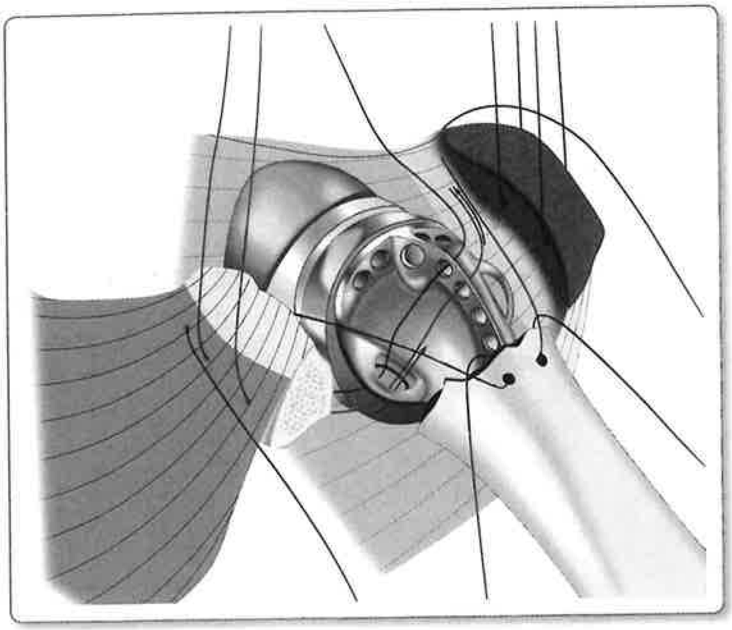

Figure 10.24 Longitudinal passage of sutures to close the lesser tuberosity.

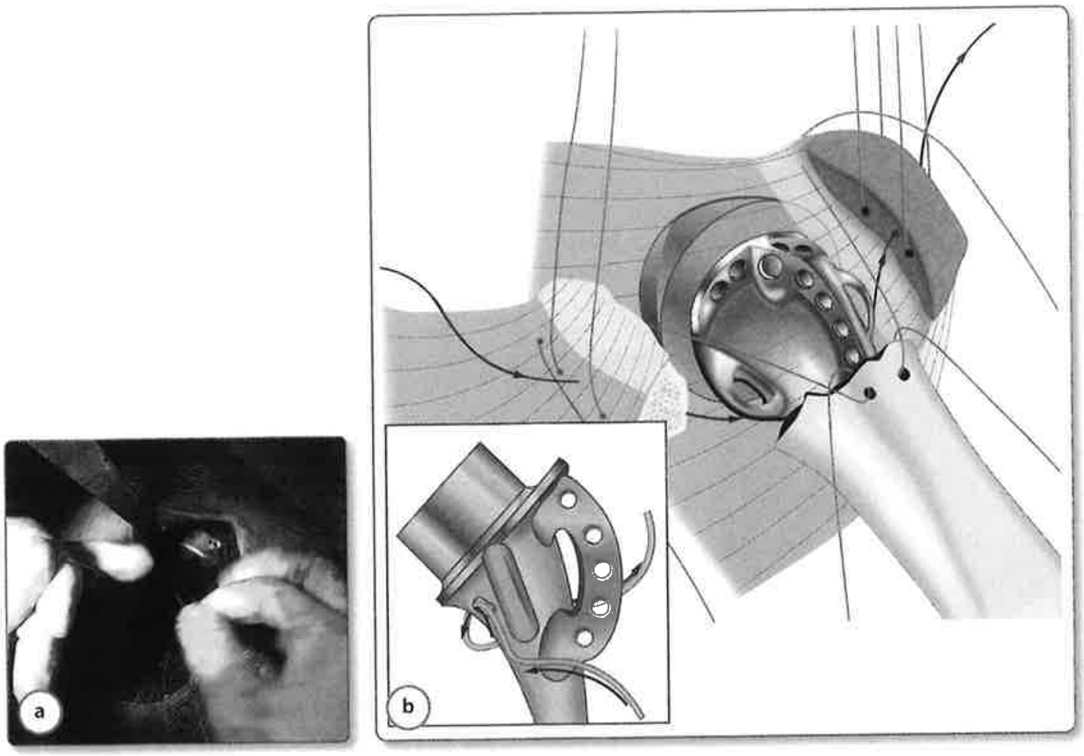

Figure 10.25 (a, b) Cerclage suture passed through the infraspinatus tendon to the medial hole of the fracture stem and through the subscapularis tendon to close the tuberosities.

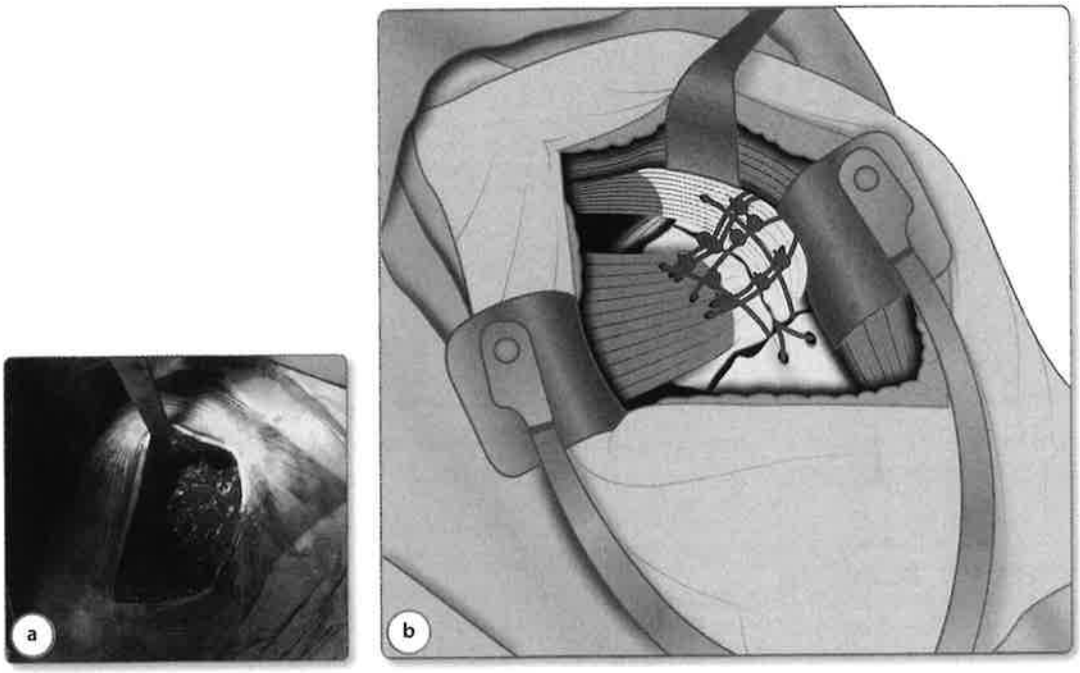

Figure 10.26 (a, b) Complete tuberosity fixation.

- Drain suction is recommended in both acute and chronic injuries to prevent hematoma formation
- The subcutaneous tissues are reapproximated and subcuticular closure performed with 2-0 absorbable suture and 2-0 monofilament suture
- After closure, it is important to perform radiographs to ensure satisfactory prosthesis position (**Figure 10.27**)

Postoperative management

- 0–2 weeks: immobilization brace positioned at 20° of abduction. Pulsed electromagnetic field therapy
- 2–4 weeks: immobilization brace positioned at 20° of abduction. Pulsed electromagnetic field therapy and passive motion 0–40° +10° every day. Pain control with NSAIDs
- 4–12 weeks: gradual recovery of range of motion with both active and passive motion exercises assisted by a physiotherapist

Outpatient follow-up

- 2 weeks: suture removal
- 4 weeks: remove sling and commence physiotherapy, if radiographs are satisfactory
- Follow up once a month with radiograph control until recovery (minimum 1 year)

Implant removal

- Only in cases of septic or aseptic mobilization

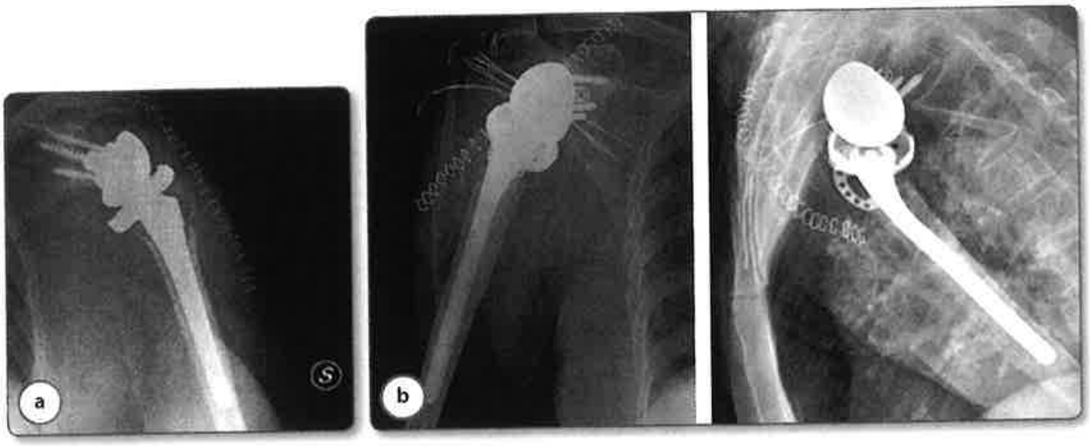

Figure 10.27 (a) Postoperative radiograph control with non-cemented stem implant. (b) Postoperative radiograph control with cemented stem implant.

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