Impingement Syndrome of the Shoulder

Christina Garving, Sascha Jakob, Isabel Bauer, Rudolph Nadjar, Ulrich H. Brunner

SUMMARY

Background: Shoulder pain is the third most common musculoskeletal complaint in orthopedic practice. It is usually due to a defect of the rotator cuff and/or an impingement syndrome.

Methods: This review is based on pertinent literature retrieved by a selective search of the Medline database.

Results: Patients with shoulder impingement syndrome suffer from painful entrapment of soft tissue whenever they elevate the arm. The pathological mechanism is a structural narrowing in the subacromial space. A multiplicity of potential etiologies makes the diagnosis more difficult; it is established by the history and physical examination and can be confirmed with x-ray, ultrasonography, and magnetic resonance imaging. The initial treatment is conservative, e.g., with nonsteroidal anti-inflammatory drugs, infiltrations, and patient exercises. Conservative treatment yields satisfactory results within 2 years in 60% of cases. If symptoms persist, decompressive surgery is performed as long as the continuity of the rotator cuff is preserved and there is a pathological abnormality of the bursa. The correct etiologic diagnosis and choice of treatment are essential for a good outcome. The formal evidence level regarding the best treatment strategy is low, and it has not yet been determined whether surgical or conservative treatment is better.

Conclusion: Randomized controlled therapeutic trials are needed so that a standardized treatment regimen can be established.

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Shoulder impingement is a clinical syndrome in which soft tissues become painfully entrapped in the area of the shoulder joint (*Figure 2*). Patients present with pain on elevating the arm or when lying on the affected side (1). Shoulder pain is the third most common musculoskeletal complaint in orthopedic practice (e1), and impingement syndrome is one of the more common underlying diagnoses (e2). On the pathophysiological level, it can have various functional, degenerative, and mechanical causes. The impingement hypothesis assumes a pathophysiological mechanism in which different structures of the shoulder joint come into mechanical conflict (1). The decision to treat conservatively or surgically is generally made on the basis of the duration and severity of pain, the degree of functional disturbance, and the extent of structural damage. The goal of treatment is to restore pain-free and powerful movement of the shoulder joint.

Learning objectives

This article should enable the reader to

- understand the causes of shoulder impingement,
- identify the affected patients and order the appropriate diagnostic tests for them, and
- know what forms of treatment are suitable.

Clinical manifestations

The affected patients are generally over age 40 and suffer from persistent pain without any known preceding trauma. The cause may be excessive stress on the shoulder joint or an apparently trivial injury. Patients report pain on elevating the arm between 70° and 120° (the “painful arc”), on forced movement above the head, and when lying on the affected side (1).

Epidemiology

A representative cross-sectional study has shown that approximately 30% of the Finnish population

Symptoms

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FIGURE 1

Overview of causes of primary subacromial impingement syndrome (SIS) and rotator cuff (RC) degeneration.

The RC can be damaged by both intrinsic and extrinsic factors, which can lead to RC rupture and to an abnormally high position of the head of the humerus. This, among other factors, can cause a non-outlet SIS. Primary SIS, in turn, leads to CAL ossification and acromial osteophyte formation. Primary SIS is to be distinguished from rarer types of shoulder impingement (gray-shaded boxes). AC, acromioclavicular; CAL, coraco-acromial ligament

over age 30 suffers from occasional or persistent shoulder pain in the course of a single month (2). Another study has shown that 16% of the population has shoulder pain in one month (e1).

Peak incidence is during the sixth decade of life (2, 3). The most common clinical diagnoses are rotator cuff defects (85%) and/or impingement syndromes (74%) (e2). The prevalence of rotator cuff defects rises with age. Up to 30% of persons over age 70 have a total defect, but 75% of such cases are asymptomatic (e3).

Relevant anatomy and types of impingement

The glenohumeral joint is a load-bearing joint with a wide range of motion (e4). The rotator cuff centers the head of the humerus in the glenoid cavity. Impingement is classified into four types, depending on the site of soft-tissue entrapment (Figure 1):

- subacromial impingement syndrome (external impingement),
- subcoracoid impingement,
- posterosuperior inner impingement, and
- anterosuperior inner impingement.

Prevalence

The one-month prevalence of shoulder pain is between 16% and 30%. Its most common causes are rotator cuff defects and impingement syndromes. Peak incidence is during the sixth decade of life.

As the subacromial impingement syndrome is by far the most common in practice, the other, rarer forms will not be discussed any further in this review.

The subacromial space is delimited caudally by the head of the humerus and the rotator cuff and cranially by the osteofibrous roof of the shoulder, which is composed of the acromion, the coracoacromial ligament, and the coracoid process. The subacromial space contains the subacromial bursa and the rotator cuff. The subacromial sliding space, biomechanically considered, constitutes an auxiliary joint between the rotator cuff and the roof of the shoulder (e3). In subacromial impingement syndrome, elevation of the arm leads to an abnormal contact between the rotator cuff and the roof of the shoulder (Figure 2).

Etiology

The subacromial impingement syndrome has both primary and secondary forms. Primary impingement is due to structural changes that mechanically narrow the subacromial space (1); these include bony narrowing on the cranial side (outlet impingement), bony malposition after a fracture of the

Etiology

Primary subacromial impingement is due to mechanical narrowing of the subacromial space, while secondary subacromial impingement is due to a functional disturbance.

greater tubercle, or an increase in the volume of the subacromial soft tissues – due, e.g., to subacromial bursitis or calcific tendinitis – on the caudal side (non-outlet impingement) (Figure 1) (1). Secondary impingement results from a functional disturbance of centering of the humeral head, such as muscular imbalance, leading to an abnormal displacement of the center of rotation in elevation and thereby to soft tissue entrapment (1).

Advanced subacromial impingement syndrome is associated with rotator cuff defects. The relation between these two entities is a controversial matter (4). Rotator cuff defects have been attributed to both intratendinous (intrinsic) abnormalities and extratendinous (extrinsic) factors. The extrinsic compression theory postulates pressure damage due to pathological contact of the shoulder roof with the supraspinatus (SSP) tendon in subacromial impingement syndrome (5, e5). In contrast, the intrinsic compression theory postulates degenerative processes in the SSP tendon itself, leading to defects. Rotator cuff damage can lead secondarily to narrowing of the subacromial space and to the development of subacromial impingement syndrome (5). It is now thought that both of these pathological mechanisms are active, and that they reinforce each other (e6).

The development of outlet impingement may be favored by certain bony constellations of the roof of the shoulder, e.g., a hooked acromion (Bigliani type III; Figure 3) (6, 7, e7). Other possible causes include bone spurs of the acromion, acromioclavicular (AC) joint osteophytes, or an os acromiale (1).

A further risk factor is excessive coverage of the shoulder joint by the acromion (8), which can be assessed quantitatively by the critical shoulder angle (CSA) or the acromiohumeral index (AI) (Figure 4) (9). Smoking predisposes to subacromial impingement syndrome as well as to intrinsic damage of the rotator cuff (e8).

Diagnostic evaluation

Clinical history-taking and a thorough physical examination are the basis of the diagnostic assessment. The diagnostic sensitivity of physical examination is 90% (e9). Imaging studies (initially, plain x-rays) are indispensable for differential diagnosis and for the exclusion of calcific tendinitis or arthritic changes. If the patient has had a circum-

Figure 2: Anatomical overview of the shoulder (left, above), showing the mechanism of subacromial impingement with painful entrapment of soft tissues (arrows, right, above) on elevation of the arm, due to pathological contact of the humeral head with the roof of the shoulder joint, particularly the anterolateral portion of the acromion (below). From: Habermeyer P: Schulterchirurgie, 4th ed., 2010 (1). Reproduced with the kind permission of Elsevier GmbH, Urban & Fischer, Munich, Germany

Figure 3: Acromial shapes as classified by Bigliani and Morrison: type I (flat), type II (curved), type III (hooked)

scribed functional limitation or persistent pain for 6 weeks or more despite the usually adequate analgesia and physical therapy, further imaging studies and referral to a specialist are recommended.

History and physical examination

The patient should be asked about the nature, duration, and dynamics of the pain and about any precipitating trauma (perhaps trivial trauma) or stress, as well as about analgesic use. Patients often report painful elevation and depression of the arm between 70° und 120°, pain on forced movement above the head, and pain when lying on the

Basic diagnostic evaluation

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History

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Figure 4: Critical shoulder angle and acromiohumeral index

a) Critical shoulder angle (CSA): the angle (black lines) is measured from the inferior pole of the glenoid between the glenoid plane and the lateral border of the acromion. A wide CSA is a risk factor for rotator cuff lesions. b) Acromiohumeral index (AI): this is the quotient of the distance from the glenoid surface to the lateral end of the acromion (GA, dotted arrow) and the distance from the glenoid surface to the lateral end of the humeral head (GH, black arrow): by definition, $AI = GA/GH$. A high AI is also a risk factor for rotator cuff lesions

affected shoulder (1). The physical examination consists of inspection, palpation, and passive and active range-of-motion testing of the shoulder, with attention to scapular dyskinesia and hyperlaxity or instability of the glenohumeral joint. Strength is tested in comparison to the opposite side. In subacromial impingement syndrome, weakness mainly affects abduction or external rotation. Testing includes the active and passive range of motion, isometric contraction testing for the selective determination of strength in internal and external rotation and in abduction, and additional impingement tests. The sensitivity and specificity of such tests is low individually, but, taken together, they are indispensable for the differential diagnosis (10–12). Examining techniques are summarized in *Box 1*.

Diagnostic local infiltration

Under sterile precautions, local anesthetic is applied subacromially so that subacromial pain can be differentially diagnosed (the impingement test of Neer).

Physical examination

Clinical tests, such as the so-called painful arch or the Hawkins test, provide initial evidence of the underlying disturbance, on the basis of which further diagnostic studies can be obtained.

Ultrasonography

Impingement-associated entities such as bursitis and tendon changes or ruptures are visualized in standard tomographic planes with a 5–12 MHz linear transducer. Bursitis is characterized ultrasonographically by an anechoic effusion and a thickened bursa wall; initial tendon changes display high echogenicity and thickening, especially of the SSP tendon (13, 14).

Plain x-rays

The conventional x-ray series of the shoulder consists of a true AP (anteroposterior) view, a Y (outlet) view, and a transaxillary view. These three views enable the display of the bony structures so that the physician can assess the state of the coraco-acromial arch, the acromioclavicular joint, the centering of the head of the humerus, the greater tubercle, arthritic changes, and normal anatomic variants.

With respect to the subacromial impingement syndrome in particular, there are further opportunities to display typical abnormalities that are of

The utility of plain x-rays

Plain x-rays enable visualization of the bony structures, yielding findings that are of therapeutic and prognostic significance.

prognostic importance: the shape of the acromion (*Figure 3*) is seen in the outlet view. The critical shoulder angle (CSA), measured in the AP view, incorporates both the inclination of the glenoid and the extent of lateral coverage by the acromion (*Figure 4*). The risk that the patient will develop a rotator cuff lesion is higher if the CSA exceeds 35°, while the risk of shoulder arthritis is higher if the CSA is less than or equal to 35° (9).

The acromiohumeral index (AI) characterizes the lateral extension of the acromion (*Figure 4*) as the quotient of the distance from the glenoid surface to the lateral acromion (GA) and the distance from the glenoid surface to the lateral end of the humeral head (GH): by definition, $AI = GA/GH$. A high AI indicates a marked lateral extension of the acromion, which is significantly associated with a greater risk of rotator cuff tears and is considered an unfavorable prognostic factor after rotator cuff refixation (15). The acromiohumeral distance (AHD) is the distance, measured on the AP view, from the lower edge of the acromion to the humeral head; it is typically approximately 10 mm (7–14 mm) in men and 9.5 mm (7–12 mm) in women (1). An abnormally low AHD on the AP view indicates a defect of more than one rotator cuff tendon (16).

Magnetic resonance imaging

Magnetic resonance imaging (MRI) is used to assess the soft tissues, including the labrum capsular apparatus, the bursae, and the rotator cuff, and to determine the degree of muscle atrophy (Zanetti and Thomazeau classification) and fatty infiltration (Goutallier classification) (14, e10–e12). MRI is the imaging study of choice for classifying tendon retraction and assessing the musculature.

The reported sensitivity and specificity of noncontrast MRI are 92% and 93%, respectively (17). Lessened peritendinous fat, indentation of a tendon by the coraco-acromial arch, and hyperintense signal are all indications of an impingement syndrome.

In the technique of direct MR arthrography, gadolinium-containing contrast material is injected into the glenohumeral joint before an MRI is obtained (e13). This enables better detection of additional damage within the joint cavity, e.g., partial supraspinatus lesions or biceps tendon abnormalities (15).

Soft-tissue evaluation with MRI

Magnetic resonance imaging (MRI) is used to assess the rotator cuff, the bursa, and, in particular, the musculature.

BOX 1

Methods of physical examination for the evaluation of shoulder impingement syndrome

● Hawkins test

Positive when pain arises on maximal internal rotation of the arm in 90° of anteversion with the elbow flexed. This narrows the subacromial space between the greater tubercle and the coracoacromial ligament, causing pain.

● Neer sign

One hand fixes the scapula while the other elevates and internally rotates the arm. This causes painful contact of the greater tubercle with the roof of the shoulder joint.

● Jobe test

Both of the patient's arms are held in 90° of abduction, 45° of flexion, and internal rotation. The patient tries to elevate the arms further against the examiner's marked resistance.

● Painful arch

Pain on abduction, with extended elbow, in the scapular plane between 60° and 120° indicates pathology in the subacromial space.

Computed tomography

Computed tomography (CT) plays a secondary role in the evaluation of impingement syndrome. Its value is mainly in the display of bony changes.

Treatment options and indications

The goal of treatment is to eliminate pain and restore joint function. Good and very good results can be achieved with conservative and surgical methods in approximately 80% of cases (18). There are still no valid measuring instruments or prospective studies showing which patients stand to benefit from conservative treatment or from surgery (19–21). There is as yet no German guideline on this topic; a Dutch guideline on subacromial pain was issued in 2014 (22). The formal evidence level for the effectiveness of individual conservative treatment approaches is only moderate overall.

Treatment methods

The goal of treatment is to eliminate pain and restore joint function. Good and very good results can be obtained in approximately 80% of cases with either conservative or surgical treatment.

BOX 2

Conservative treatment options

- Immobilization
- Nonsteroidal anti-inflammatory drugs (NSAID)
- Cortisone injections
- Physical therapy
- Ultrasound
- Application of heat and electricity
- Manual therapy
- Elastic therapeutic tape
- Acupuncture

The choice of a suitable treatment for impingement is not determined exclusively by the symptoms and pathological changes; rather, it should always be made after thorough discussion with a well-informed patient.

Conservative treatment

In the absence of major structural damage, conservative multimodal treatment for 3–6 months is the initial therapy of choice. The treatment mainly addresses pain at first, then passive and active motion, and lastly strength and coordination. A wide range of treatment methods is available for these purposes (*Box 2*).

It is advisable to favor the affected arm in the acute phase, avoiding overhead movement, rapid movement, and heavy mechanical loading of the joint.

The regular administration of anti-inflammatory drugs for 1–2 weeks to reduce pain is also important (23, e14), although the available evidence for this is currently on a low level (level III). A recent meta-analysis revealed a weakly positive effect of anti-inflammatory drugs for pain reduction compared to placebo (standardized mean difference [SMD]: -0.29 ; 95% confidence interval [-0.53 ; -0.05]) (e15). An SMD of ± 0.2 , ± 0.5 , or ± 0.8 is conventionally said to correspond to a weak, intermediate, or strong effect, respectively.

Next, the mobility of the joint should be gradually increased. Loosening massages and physical measures (24) including heat or cold application, electrotherapy (iontophoresis), and exercise pools are an evidence-based standard for treatment in this phase (evidence level II). These methods serve to reduce pain and improve shoulder mobility.

Corticosteroid injections to lessen acute pain and improve shoulder mobility in the first eight weeks are a standard form of treatment supported by level I evidence (25, e16). The drug must be injected in the vicinity of the tendons, not into the tendons themselves. The injections should be repeated no earlier than 3–4 weeks after the initial injection, and no more than 2 or 3 times (e17). Patients treated with cortisone injections, compared to untreated controls, have significantly better pain relief (SMD: -0.65 [-1.04 ; -0.26]) and joint mobility (SMD: -0.56 [-1.06 ; -0.05]) (e15). Sterile precautions and informed consent, with special mention of the risk of infection and other side effects including diabetes mellitus, are very important. Infection after subacromial infiltration has only been described in a few case reports; exact figures on its incidence are lacking.

Shock-wave therapy is used to treat calcific tendinitis (26, e18). High-energy shock waves lead to the disintegration of calcifications (level I evidence). Low-energy shock waves can be used to alleviate pain but have no role to play in the conservative treatment of impingement syndrome.

Once the acute pain has been treated, emphasis is placed on physiotherapeutic measures for mobilization. There is level I–II evidence for these measures (27), which serve to reduce pain and improve mobility. Targeted exercises, compared to no treatment, are effective both in reducing pain (SMD: -0.94 [-0.69 ; -0.19]) and in improving mobility (SMD: -0.57 [-0.85 ; -0.29]) (e15). Patient gymnastics are initially combined with stretching and swinging exercises and with passive movement. After pain reduction, the scapula is mobilized; for this purpose, the movement patterns of proprioceptive neuromuscular facilitation (PNF) can be used.

Simple exercises that the patient can perform unaided are important. Matsen (28) has pointed out the value of the exercise program devised by the physiotherapist Sarah Jacksin (*Box 3*). The main exercises in this category are centered exercises to

Conservative treatment

Multimodal conservative treatment is the first step. Initially, the shoulder joint is rested and adequate analgesia is given; thereafter, the joint is set in motion both by physiotherapy and by exercises that the patient can carry out independently.

Cortisone injections

Cortisone can be injected in targeted fashion, together with a local anesthetic, in the subacromial space or the glenohumeral joint. To prevent injury to the tendons, this should not be done more than 2–3 times.

strengthen the rotator cuff and posture training to keep the spine erect and stabilize the scapula (29).

Subacromial infiltration is a reasonable form of treatment, although its effect is small and transient. In a retrospective study of 616 patients with 27 months of follow-up, 67% obtained satisfactory results from treatment with nonsteroidal anti-inflammatory drugs (NSAID) and physiotherapy (30). A meta-analysis conducted in 2015 showed that the best pain reduction can be achieved with a combination of movement exercises and the measures listed in *Box 3* (31).

Surgery

Approximately 30% of patients undergo surgery after ineffective conservative treatment (30). Surgery is indicated if the symptoms fail to improve after 3 or more months of conservative treatment (30). Caution is advised if the diagnosis is unclear or in the setting of marked restriction of glenohumeral movement, muscle atrophy, mental illness, or a relevant underlying neurological disease.

Surgical methods

Subacromial decompression: This involves removal of the anterior and lateral portions of the undersurface of the acromion (5–8 mm) and detachment of the coraco-acromial ligament (*Figure 5*). According to Neer (e19), open anterior acromioplasty with resection of the coraco-acromial ligament is the treatment of choice for chronic impingement syndrome; this procedure involves a short anterolateral cut. In the classic method, the acromial portion of the deltoid muscle is detached, while in the so-called mini-open technique the deltoid fibers are bluntly separated and the muscle is left attached to the bone.

The arthroscopic technique was described by Ellman in 1987 (e20) and has been reported to yield good or very good results, with complete relief of pain and unimpaired load-bearing by the shoulder joint (4, 19). In a meta-analysis, Dong et al. (31) concluded that arthroscopic decompression is superior, despite the lack of demonstration of a better outcome compared to open decompression.

Bursectomy: As the bursa is usually affected by inflammatory changes, this tissue is removed. A randomized trial showed no difference in the functional outcome of bursectomy with and without additional

BOX 3

The Jacksin program for stepwise shoulder training

The patient is given simple exercises to carry out independently several times a day for several weeks.

Step 1

Avoiding mechanisms of repetitive injury

- The painful stimulus should be avoided, e.g., by modifying body posture at work or stress on the shoulder during sporting activities. Nonsteroidal anti-inflammatory drugs (NSAID) should be given.

Step 2

Achieving free joint mobility

- Subacromial irritation restricts passive movement, e.g., by shortening the posterior capsule. Stretching exercises performed independently several times a day help overcome this problem.

Step 3

Strengthening the shoulder joint

- Once the shoulder joint has regained full mobility, the next objective is to build up the muscle. Exercises for this purpose can be carried out with an elastic latex band or a pulley. Persons who are active in sports should not return to their sport before they have regained full strength.

Step 4

Conditioning through endurance sports

- Persons who are out of condition should improve their overall fitness by training in endurance sports.

Step 5

Adapting work and sporting activities

- Finally, the mechanical stresses of everyday life are carefully analyzed: individual movements carried out at work and in sporting activities are examined and improved. Excessive stress on the shoulder must be avoided at every stage.

acromioplasty, but the acromion type and the nature of symptoms did have an effect on the outcome (32–34).

Coplaning: This is the removal of inferior acromial osteophytes and of the lateral end of the clavicle without total resection of the acromioclavicular (AC) joint. Coplaning is controversial, as it may cause symptoms relating to the joint. An all-or-nothing rule has been proposed: in patients with painful AC joint arthritis documented by clinical testing and radiological confirmation of active inflammation, the joint should be

Surgery

Surgery is indicated only if the symptoms, physical examination, and imaging findings are concordant. It is contraindicated if no structural abnormality is suspected.

Subacromial decompression

Subacromial decompression combined with bursectomy is considered a standard treatment of impingement. The undersurface of the acromion is smoothed and the coracoacromial ligament is gently detached.

Figure 5: Subacromial decompression in a patient with an anterolateral bone spur. a) Bone spur on the anterolateral portion of the acromion (above the red line) in an arthroscopic view from posterior, with an electrosurgical probe and bursa fragments at the lower edge of the image. c) The spur (red line) can also be seen on an anteroposterior (AP) shoulder x-ray. b) The same operative field after arthroscopic decompression: the lateral extension of the acromion is now flat (above the red line). A bone drill can be seen at the lower edge of the image. d) The x-ray shows the surgically widened subacromial space and the flat lower edge of the acromion (red line)

resected in an open or arthroscopic procedure, along with 3–4 mm of the acromion and of the clavicle. Clavicular stability is preserved by the coracoclavicular ligaments and also, if the arthroscopic technique is used, by the cranial and posterior ligaments of the AC joint.

Rotator cuff damage: Lesions of the rotator cuff can be partial—affecting the articular part of the joint, the bursa, or the tendons—or total (rupture). Complete ruptures are assessed in terms of their size, the number and nature of the affected tendons, and retraction, fatty

Bursectomy

As the bursa is usually affected by inflammatory changes, this tissue is removed. A randomized trial showed no difference in the functional outcome of bursectomy with and without additional acromioplasty.

Coplaning

In this controversial technique, inferior acromial osteophytes and the lateral end of the clavicle are removed without total resection of the acromioclavicular (AC) joint.

degeneration, and atrophy of the corresponding muscles. These factors are of prognostic significance regardless of whether an open or an arthroscopic technique is used (Box 4).

Surgery is indicated if the patient is suffering from pain and a disturbing loss of function; age plays a steadily less important role. Surgery is particularly favored for younger patients, those with high functional requirements, and those whose impingement syndrome was caused by trauma. All traumatic ruptures and all ruptures of the subscapularis tendon are absolute indications for surgery.

Surgery can be performed by the mini-open approach using a delta split, via arthroscopy, or with a combined technique. At present, arthroscopy and open surgery yield equivalent results (35). After debridement of the bone adjacent to the tendon, the tendon is repositioned with a transosseous technique or with so-called suture anchor systems, with a closure that is as free of tension as possible.

Limiting factors for reconstruction include tissue quality, defect size, and fatty degeneration of the musculature. In such situations, it may be useful to perform a partial closure (partial reconstruction) by lessening the size of the defect and restoring mechanically coupled muscle pairs (subscapularis and infraspinatus mm.). Soft-tissue debridement and tenotomy of the long tendon of the biceps is an option for elderly patients and for those who have irreparable defects with a high-lying humeral head, but without glenohumeral arthritis and with intact function of the joint (36).

For young patients without arthritis who have irreparable rotator cuff defects, a muscle/tendon transfer should be considered (37). For posterolateral defects, the tendons of the latissimus dorsi and teres major muscles are used; for anterior/anterolateral defects, the pectoralis major tendon is used. Decellularized subcutis or skin (of animal or human origin) can now be used for tendon augmentation. The onlay technique is recommended, and interposition between tendon and bone is not, because of a lack of stability. For unreconstructable superior defects of the rotator cuff, centering can be improved by a superior capsular reconstruction with auto- or allografting. These techniques are not supported by extensive evidence and are therefore only performed for special indications in shoulder centers.

For patients with irreparable rotator cuff lesions, especially elderly patients who have shoulder arthritis as well, the implantation of an inverse shoulder endopro-

BOX 4

Predictors of an unfavorable outcome after rotator cuff reconstruction or of an unreconstructable rupture

- Severe muscle atrophy and fatty degeneration
- Involvement of more than two tendons
- Preoperative acromiohumeral distance (AHD) less than 7 mm
- Weak external rotation
- Positive external rotation lag sign

thesis is the best treatment option (e21). Distalization and medialization of the center of rotation of the shoulder puts the deltoid muscle under tension and thereby restores shoulder function.

Complications

Misdiagnoses, wrong indications (40%), and technical errors (40%) lead to persistent symptoms after subacromial decompression (38). The reasons for bad outcomes include persistent rotator cuff defects and persistent untreated disease of the acromioclavicular joint or of the long biceps tendon.

Acromioplasty should be performed with close attention to the individual anatomy. Common errors include wrong localization due to inadequate orientation and excessive acromion resection associated with weakening of the deltoid attachment and injury of the acromioclavicular joint medially. Rare complications include rigidity of the shoulder (adhesive capsulitis) and infections, with a reported frequency well under 0.5%.

Conflict of interest statement

Prof. Brunner has served as a paid consultant for Wright & Tornier and has received reimbursement of meeting participation fees and travel expenses from Wright Tornier, Medi, and Arthrex.

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Rotator cuff defects in addition

Rotator cuff defects do not necessarily require surgical repair. The indication depends on individual performance requirements, the constellation of defects, and the state of the muscle tissue, and only to a lesser extent on the age of the patient.

The treatment of irreparable lesions

For patients with irreparable rotator cuff lesions, especially elderly patients who have shoulder arthritis as well, the implantation of an inverse shoulder endoprosthesis is the best treatment option.

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Complications

Surgical complications are rare. Damage arising from wrong indications or technical errors must be avoided.

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Supplementary material

e-References:

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Please answer the following questions to participate in our certified Continuing Medical Education program. Only one answer is possible per question. Please select the answer that is most appropriate.

Question 1

When is rotator cuff reconstruction absolutely indicated?

- a) at 3 months, regardless of the size of the defect
- b) if the lesion is partial and painless
- c) in an elderly patient with a partial lesion
- d) if there is a longstanding, severe tendon defect
- e) in a young patient with a defect of traumatic origin

Question 2

Which of the following measures plays no role in the conservative treatment of impingement syndrome?

- a) cortisone injections
- b) physiotherapy
- c) analgesia with NSAID
- d) independently performed exercises
- e) shock-wave therapy

Question 3

In what circumstances is surgery for impingement syndrome not indicated?

- a) if the symptoms have been present for several months
- b) if there is a documented lesion of the supraspinatus tendon
- c) if there is marked restriction of glenohumeral movement
- d) if the patient is young and has high functional requirements
- e) if there is accompanying pathology

Question 4

What test is useful in the diagnostic assessment of shoulder impingement syndrome?

- a) the Finkelstein test
- b) the Schirmer test
- c) the Jobe test
- d) the Watson–Shift test
- e) the Phalen test

Question 5

The glenohumeral joint is a load-bearing joint. Which of the following soft-tissue structures plays an active role in the centering of the humeral head in the glenoid cavity?

- a) subscapularis muscle
- b) coracoacromial ligament
- c) greater tubercle
- d) subacromial bursa
- e) pectoralis major muscle

Question 6

A 60-year-old man complains of loss of strength in an arm and difficulty getting dressed. His symptoms persist despite regular physiotherapy and multiple cortisone injections. Magnetic resonance imaging reveals a type III acromion and a complete rupture of the supraspinatus tendon. The tendon is well preserved, without retraction or fatty degeneration. How should this patient be treated?

- a) Intensified physiotherapy should be provided.
- b) Because of the patient's age, surgery is no longer an option.
- c) Surgical decompression with rotator cuff reconstruction is indicated.
- d) Another series of intra-articular injections should be performed.
- e) Because of the patient's age, the surgical treatment should be restricted to tendon debridement.

Question 7

Subacromial impingement syndrome is often associated with rotator cuff ruptures. Which of the following is a predisposing factor for intrinsic rotator cuff damage?

- a) AC joint arthritis
- b) acromial osteophytes
- c) greater tubercle fractures
- d) smoking
- e) activities in the kneeling position

Question 8

A 52-year-old woman complains of longstanding pain during activities in which her arms are held above her head, as well as at night when she lies on the affected side. Physical examination reveals a painful arc. What further diagnostic evaluation is indicated?

- a) After thorough history-taking and physical examination, you order computed tomography (CT).
- b) After thorough physical examination and ultrasonography, you order plain x-rays of the affected side and possibly local-anesthetic infiltration to clarify the diagnosis, followed by magnetic resonance imaging (MRI).
- c) No further evaluation is needed: the patient clearly has a shoulder impingement syndrome, and surgery is indicated.
- d) If the ultrasound is normal, no further imaging studies are indicated.
- e) As the shoulder impingement syndrome is a self-limiting illness, you examine the patient and then initiate conservative treatment with analgesics, physiotherapy, and physical treatment measures.

Question 9

In a patient with confirmed shoulder impingement syndrome, plain x-rays and an MRI of the affected shoulder are obtained. What finding is *not* typical of impingement syndrome?

- a) high humeral head position in the true AP view
- b) a hooked acromion
- c) reduced peritendinous fat, tendon indentation, and an abnormality of the coracoacromial arch on MRI
- d) a critical shoulder angle (CSA) less than 35° and a low acromio-humeral index
- e) complete rupture of the supraspinatus tendon with tendon retraction in the coronal T₁-weighted MRI sequence

Question 10

In subacromial impingement syndrome, soft tissue is trapped between the roof of the shoulder and the head of the humerus. The syndrome has primary and secondary forms. Which of the following can be a cause of secondary subacromial impingement syndrome?

- a) subacromial bursitis
- b) type III acromion
- c) muscular imbalance of the rotator cuff
- d) os acromiale
- e) type I acromion

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Supplementary material to:

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