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Special Issue: Shoulder Instability

Guest Editor: Amol Tambe

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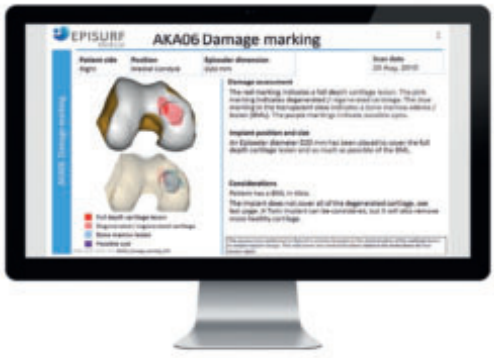

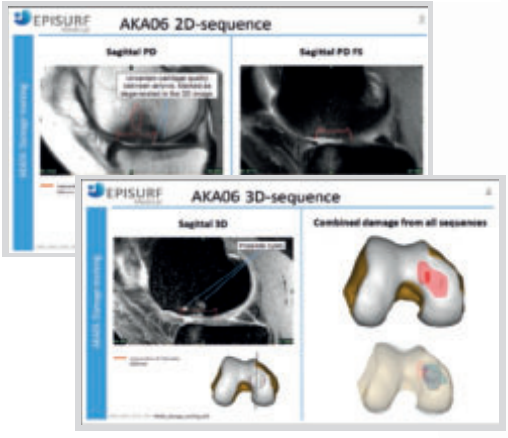

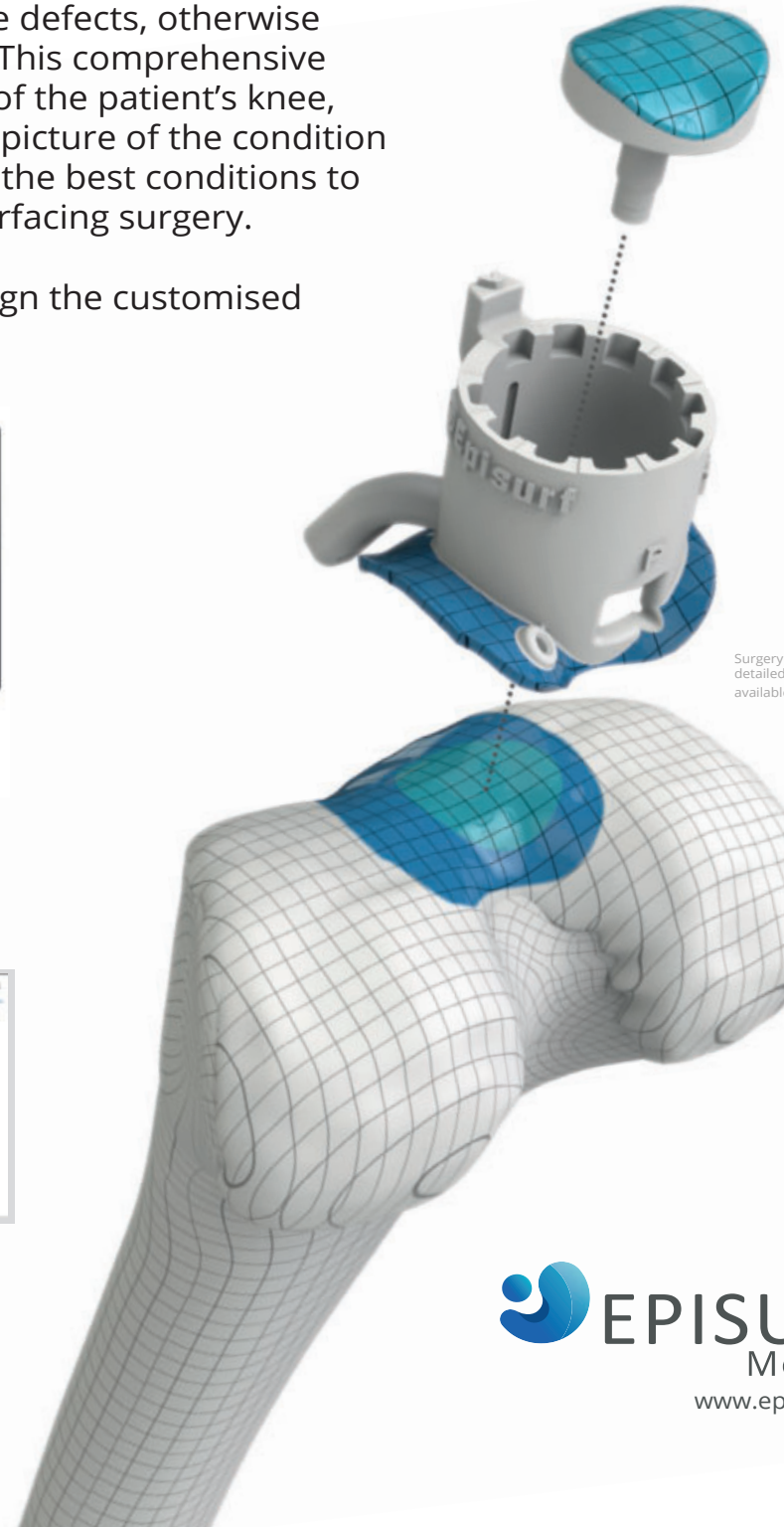

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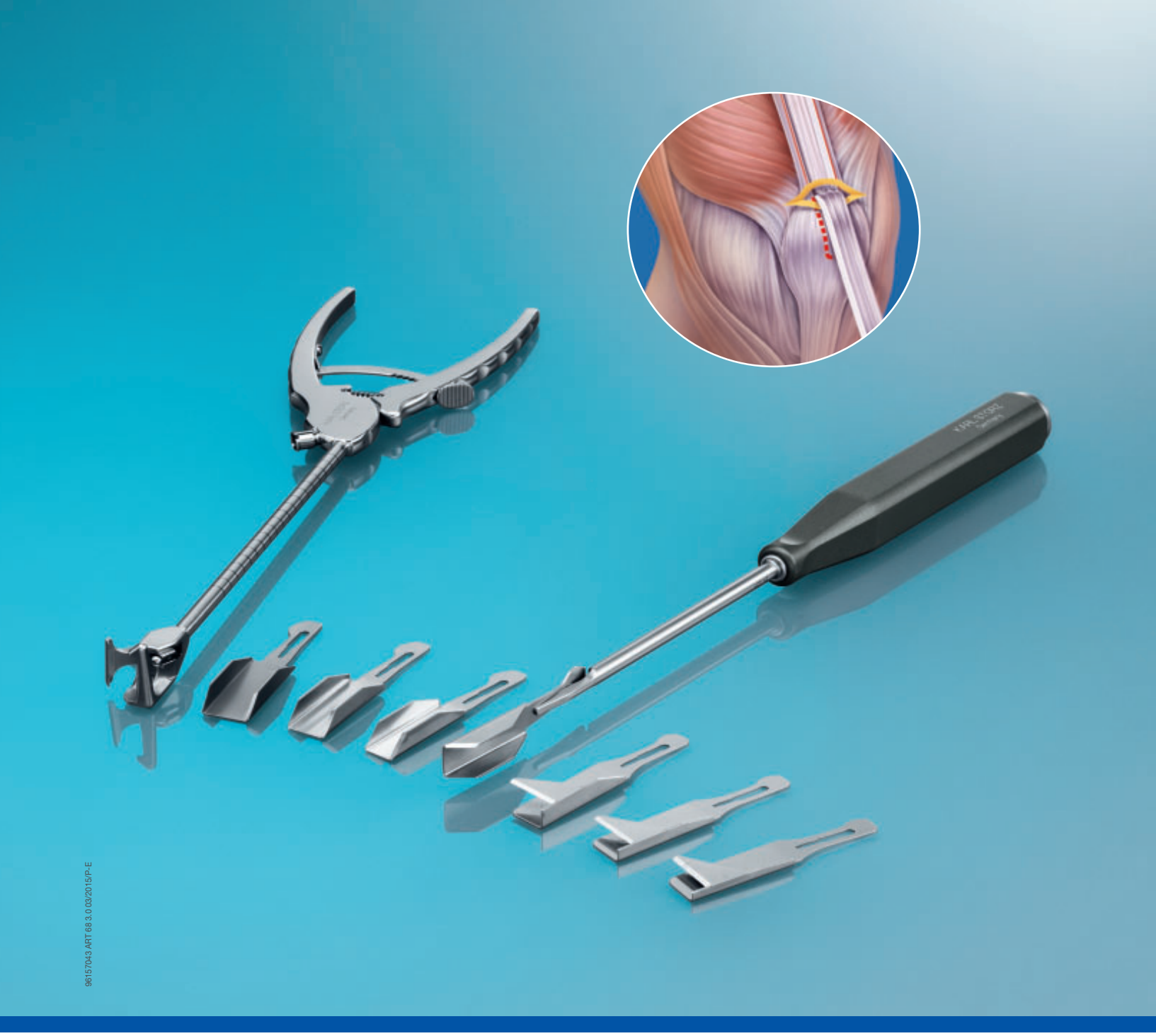

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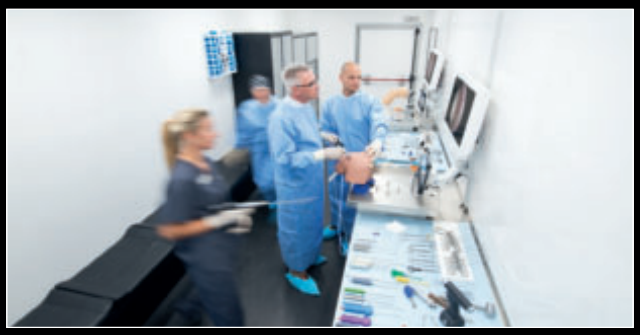

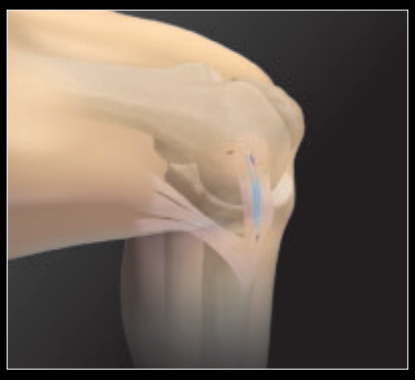

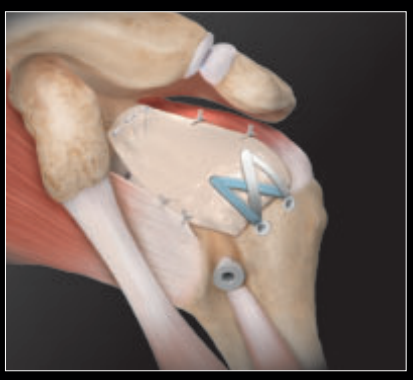

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Anterior shoulder instability in collision and contact athletes

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ABSTRACT

Glenohumeral instability is a common problem for the collision and contact athlete. An understanding of the pathoanatomy, aetiology and injury mechanisms can help guide the clinical examination and appropriate investigations. This in turn can help guide appropriate management of patients, with the aim to return them to pre-injury levels of sport.

Contents

1. Introduction

Glenohumeral instability is a common disability for the collision and contact athlete. It accounts for 23% of shoulder injuries in American Collegiate Athletes,[1] and in Australian professional rugby union players was the soft tissue injury that led to the greatest time off.[2] Similar results were found in the UK professional rugby competition where glenohumeral instability results in the highest rate of absence from playing and training and has the highest recurrence of all shoulder injuries.[3] Rugby league, Australian Rules football, lacrosse and ice hockey all had similar high rates of shoulder injuries and instability.[4–7]

Collision and contact sports are often treated as the same patient group. Collision sports are best described as sports where the athletes purposely and repeatedly collide at high force with each other or inanimate objects, such as the ground. Sports such as rugby union, rugby league, lacrosse, American football and boxing are typical collision sports. In contrast, in contact sports whilst collisions still occur regularly during the game, such as soccer and basketball[8,9] they usually involve lower levels of force. It may be important to differentiate between these two groups, as we know that a sport such as rugby union has a specific and different high velocity injury pattern to many other sports.[10,11]

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2. Pathoanatomy of anterior instability

The glenoid labrum improves the stability and depth of the glenohumeral articulation[12] but also act as the insertion of the glenohumeral ligaments to the glenoid. Removal of the labrum in cadaveric specimens leads to easier dislocation in the anterior and inferior direction.[13] Avulsion of the labral attachment of the antero-inferior glenohumeral ligament (AIGHL), between the 3 and 5 o'clock position, in traumatic anterior shoulder instability, was described in detail by Blundell Bankart in 1938[14] (Fig. 1). This Bankart lesion is the most common lesion seen in first time traumatic shoulder dislocations.[15],[16] However, we now understand that the soft-tissue injury not only involves avulsion of the AIGHL from the glenoid but the ligament may also avulse from the humeral side (HAGL), mid-substance capsular injuries or in combination.

The soft tissue Bankart tear can occur with an associated avulsion fracture of the anterior glenoid rim (bony Bankart lesion), particularly with the higher energy dislocations seen in collision and contact sports. Further erosive glenoid bone loss can occur in recurrent shoulder instability and has been reported as affecting up to 90% of patients.[17] Higher rates of glenoid bone defects have been found following traumatic dislocations in younger aged patients.[18] Bone loss decreases the safe zone that the humerus can pass through before becoming reliant on the AIGHL for restraint.[19] Itoi et al in 2000 found in a cadaveric model, that in the presence of glenoid bone loss of greater than 21%, repair of a soft tissue Bankart lesion failed to provide sufficient stability in translation and external rotation.[20]

Bone defects can also occur on the humerus, as a pathological impaction fracture of the posterior humeral head as described by Hill and Sachs in 1940.[21] The arthroscopic appearance of the Hill Sachs lesion was well described in 1989 by Calandra et al, who found it present in a high proportion of their instability cases.[22] Burkhart and De Beer reported a 100% failure rate for arthroscopic stabilization procedures in patients who had an engaging Hill Sachs lesion, which they defined as a defect that engages with the glenoid in a functional position of abduction and external rotation.[23] However, it is the combined relationship of bone loss on both the humerus and glenoid that determines the implications on instability. Yamamoto quantified this bipolar loss via the "glenoid track" concept. The glenoid track was defined as the contact zone between the humerus and the glenoid during maximal external rotation and increasing degrees of abduction. In a cadaveric model they mapped out this contact zone and deemed this the glenoid track. When the Hill Sachs lesion fell medial to this, they were defined as "off track" and therefore more likely to engage during physiological range. "On-track" lesions were contained within the track and therefore should not engage in physiological movement. The measurement from the posterior rotator cuff footprint to the medial margin of the normal glenoid track measured 84% of the width of the glenoid, with glenoid bone loss leading to a narrower glenoid track and potentially more "off track" lesions[24] (Fig. 1). Kurokawa et al found that "off track"" humeral lesions were associated with glenoid bone loss of at least 12%, with more than half of the patients having glenoid bone loss of greater than 20%. [25]

3. Aetiology and injury mechanism

The mechanism of injury pattern can guide the clinician to the injury and commonly occurring associated lesions. Within rugby, the injury mechanisms can be broken down into an injury involving the tackler, try-scoring injury, direct impact injury and flexed fall injury[10],[26] (Fig. 2). However, these positions are frequently replicated in all collision and contact sports.

The tackler has a posteriorly directed force applied to the abducted, externally rotated arm, usually leading to an anterior shoulder dislocation. This will often lead to the standard Bankart lesion, with SLAP tears and HAGL injuries also common.

The try-scorer has a posterior force applied with the arm in flexion rather than abduction. Whilst both Bankart tears and SLAP tears are common, rotator cuff tears are more common with this mechanism (Fig. 3).

The direct injury mechanism is when the athlete falls directly onto the lateral side of the shoulder with the arm held by the side, often in internal rotation. This exerts a large compressive force across the glenohumeral joint leading to a higher rate of bony glenoid lesions as well as complex labral tears. Fractures around the shoulder girdle as well as acromio-clavicular injuries are also common.

Flexed fall injury is the last common mechanism, where the athlete falls onto the elbow with the arm held in a flexed posture. This results in a posteriorly directed force across the shoulder joint causing higher rates of injury to the posterior shoulder, including posterior labral and glenoid damage, posterior HAGL tears and posterior rotator cuff injuries.

4. History & clinical examination

A detailed description of the mechanism of injury is crucial, as this will frequently provide much of the information required. However, shoulder instability can occur as subluxation events

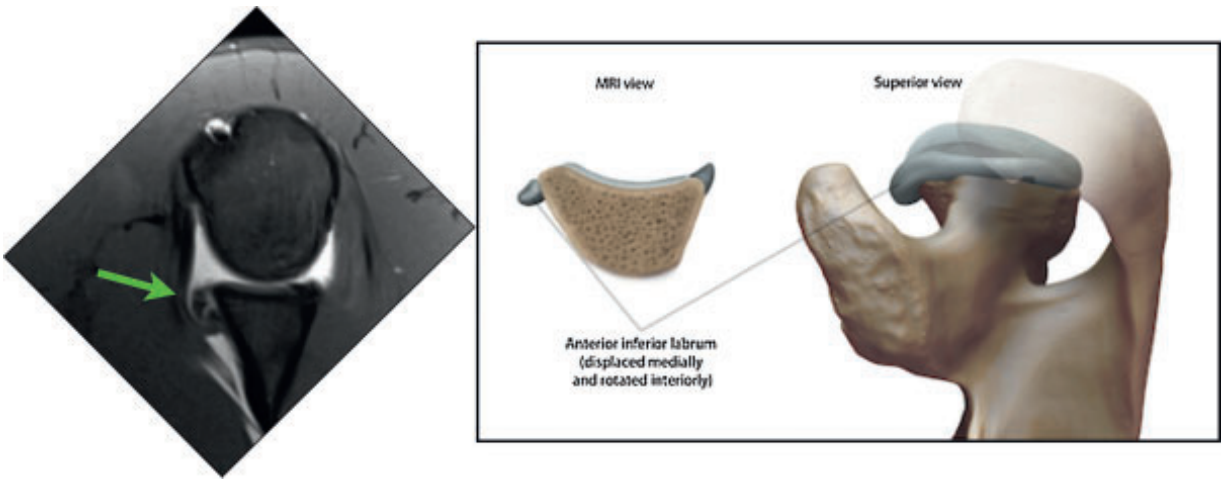

Fig. 1. Labral tear.

Antero-inferior labral tear as described by Bankart.

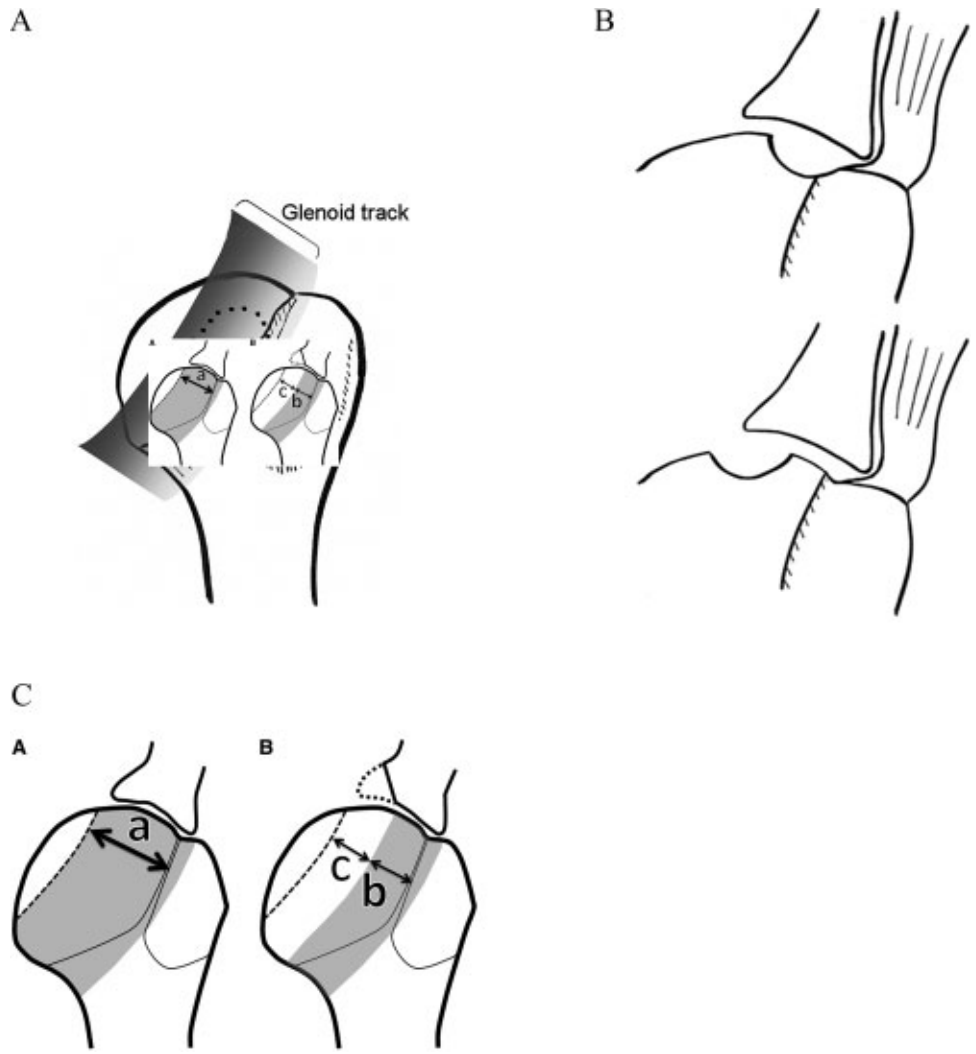

Fig. 2. A–C: Glenoid Track.
A: The glenoid track as mapped through the elevation and external rotation. B: If the Hill Sachs lesion falls within the glenoid track, in is an "on track" lesion and unlikely to engage in range of motion whereas those medial to the glenoid track, are "off track" lesion and likely to engage. With permission.[24] C: With glenoid bone loss, the glenoid track becomes narrower, and therefore a Hill Sachs lesion that was considered "on track" with no glenoid bone loss could become "off track" and more likely to engage. With permission.[25]

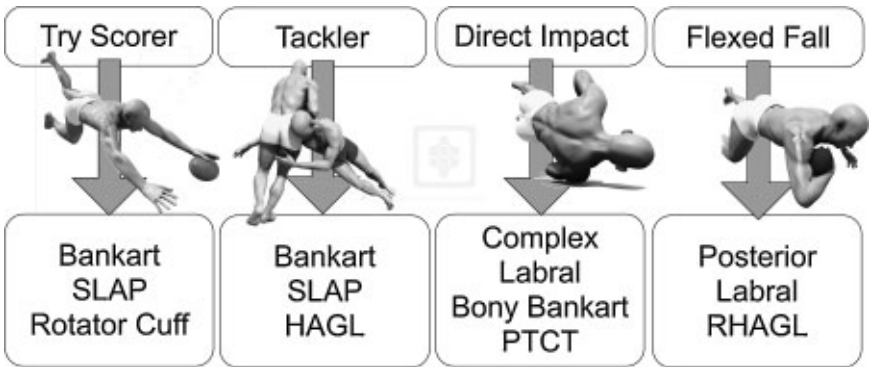

Fig. 3. Injury mechanism.
The common mechanisms of injury in collision sports, demonstrating the injury patterns that often follow.

rather than frank dislocations and the absence of an index injury does not preclude a diagnosis of instability. A subluxation is best described as translation of the glenohumeral joint beyond physiological limits not requiring manual relocation, or subluxation events may have been dislocations that self-reduced rather than required a manual reduction.[16] Subluxation events may be reported as a dead arm symptoms, pain, or weakness that would not necessarily stop them from completing a match.[27] Athletes can often play the season, but be troubled during training and often report pain after the game.[26]

Patients should be assessed for degree of generalised ligamentous laxity. This can be assessed by the criteria described by Wynne Davies[28] or by Beighton.[29] Laxity is a clinical sign of increased joint translation and is different to instability, which is a patient reported symptom. Laxity around the shoulder can be clinically assessed using the load and shift test and the sulcus sign.[30] The integrity and laxity of the inferior glenohumeral ligament can be assessed by the hyperabduction test. Gagey and Gagey found that passive hyperabduction beyond 105°, especially with passive abduction less than 90° on the unaffected side correlated with increased laxity of the inferior glenohumeral ligament complex.[31]

Anterior instability is assessed via the apprehension test, relocation and anterior release tests. These tests were found to have improved sensitivity and specificity when apprehension rather than pain was used as the definition for a positive test.[32,33] If the apprehension test is positive in midrange abduction, from 30 to 90°, and less external rotation than the standard test, 90° abduction and external rotation, this is often indicates significant glenoid bone loss.[34] Gerber and Ganz advocated the anterior draw test, assessing the degree of anterior displacement of the humeral head compared to the fixed scapula in the supine position to grade the degree of subluxation.[35]

Posterior instability in these athletes is assessed by the Kim test,[37] the Wrightington Posterior Instability Test (WPIT)[38] and the posterior apprehension test. The dynamic labral shear test[36] is also useful in athletes, in combination with the tests above for superior and posterior labral pathology. Standard assessment of the rotator cuff is vital, along with cervical spine and neurological assessment of the upper limb.

5. Investigations

Plain radiographs still have a role in the investigation of anterior shoulder instability. They have been shown to be able to detect glenoid and humeral defects, as well as provide accurate measurements of these defects.[36,37] Specific views for glenoid bone loss such as the Bernageau, West Point and Didieé[38] have been described. CT scans, which include three-dimensional reconstructions with humeral subtraction, have now become the commonly accepted standard for assessment of the glenoid in respect to fracture and bone loss[39–42] (Fig. 4).

The assessment of the capsulo-labral complex is best performed with an MRI. An MRI arthrogram (MRA), with an intra-articular injection of gadolinium, has been shown to improve the accuracy, however a recent meta-analysis has found the difference between the two modalities to be "marginal".[43] MRI accuracy of the anterior band of the inferior glenohumeral ligament (AIGHL) can be improved by imaging the shoulder in abduction and external rotation (ABER). This ABER view was shown to have a sensitivity and specificity of 94% and 82% respectively in detecting injury to the AIGHL.[44]

6. Management

The management of anterior shoulder instability in the contact and collision athlete must take a number of issues into account, with the goal of any treatment being the restoration of stability, maintenance of function and return to sport.

6.1. Non-surgical

Initial non-surgical treatment can vary, with the position and length of immobilisation controversial. Radiological studies have shown that the anterior labral structures are reduced better with the arm in external rotation compared to internal rotation,[45,46] however the clinical outcomes of external rotation slings compared to internal rotation slings have yielded mixed results.[47,48] A recent review by Whelan et al in failed to find a difference in the recurrence rate between those in a standard internal rotation sling and an external rotation sling.[49] The period of immobilisation has also not been clarified, with 2 year recurrence rates being no different between those immobilised for extended periods of time compared to early mobilisation.[50]

The risk of recurrent instability of the shoulder after non-operative treatment has been shown to be much higher in young, male contact and collision athletes.[51–55] Three systematic reviews have shown that non-surgical options have yielded high failure rates in contact and collision male athletes,[56,57] with this failure rate above 70% in those under the age of 18.[58]

Non-operative treatment might be preferred for the management of the athlete suffering an in-season shoulder dislocation. Some patients can successfully return to sport to complete the season, but in one study 37% of them suffered a repeat instability event.[59] Indications for non-operative versus operative intervention in this situation have been proposed based on the risk of recurrence and the ability for the athlete to perform sport-specific drills.[60,61] The aim of the management in this situation is to minimise further instability events until the off-season when potential surgery could occur.

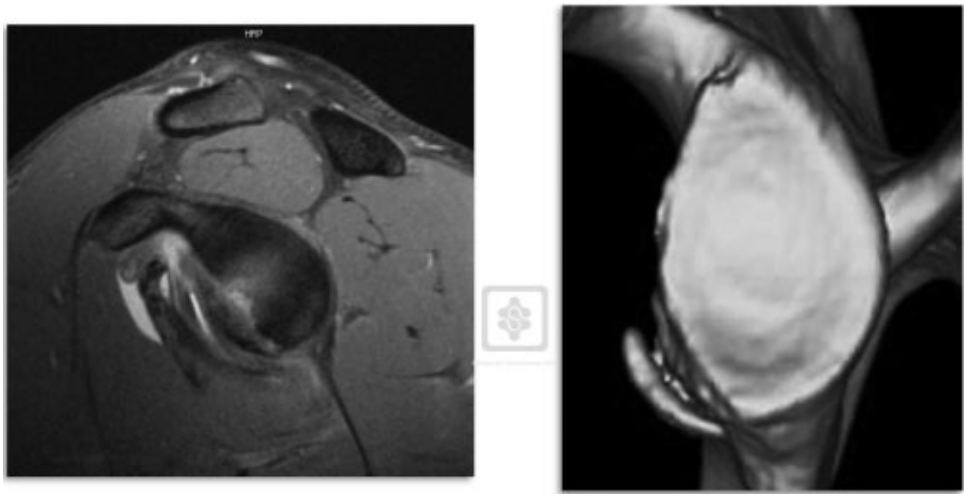

Fig. 4. Bone loss.
MRI arthrogram and CT demonstrating anterior glenoid bone loss commonly encountered in collision atheletes.

6.2. Surgical

Surgical intervention has been shown to lower the high recurrence rate and therefore surgery is often the preferred option for this patient group. Surgical intervention broadly consists of anatomical Bankart repair, bone transfers to the anterior glenoid and surgery to address the Hill Sachs lesion. Each of these procedures can be performed arthroscopically or open.

6.2.1. Bankart repair

Traditionally soft tissue labral repairs were performed using open techniques and required an approach through subscapularis.

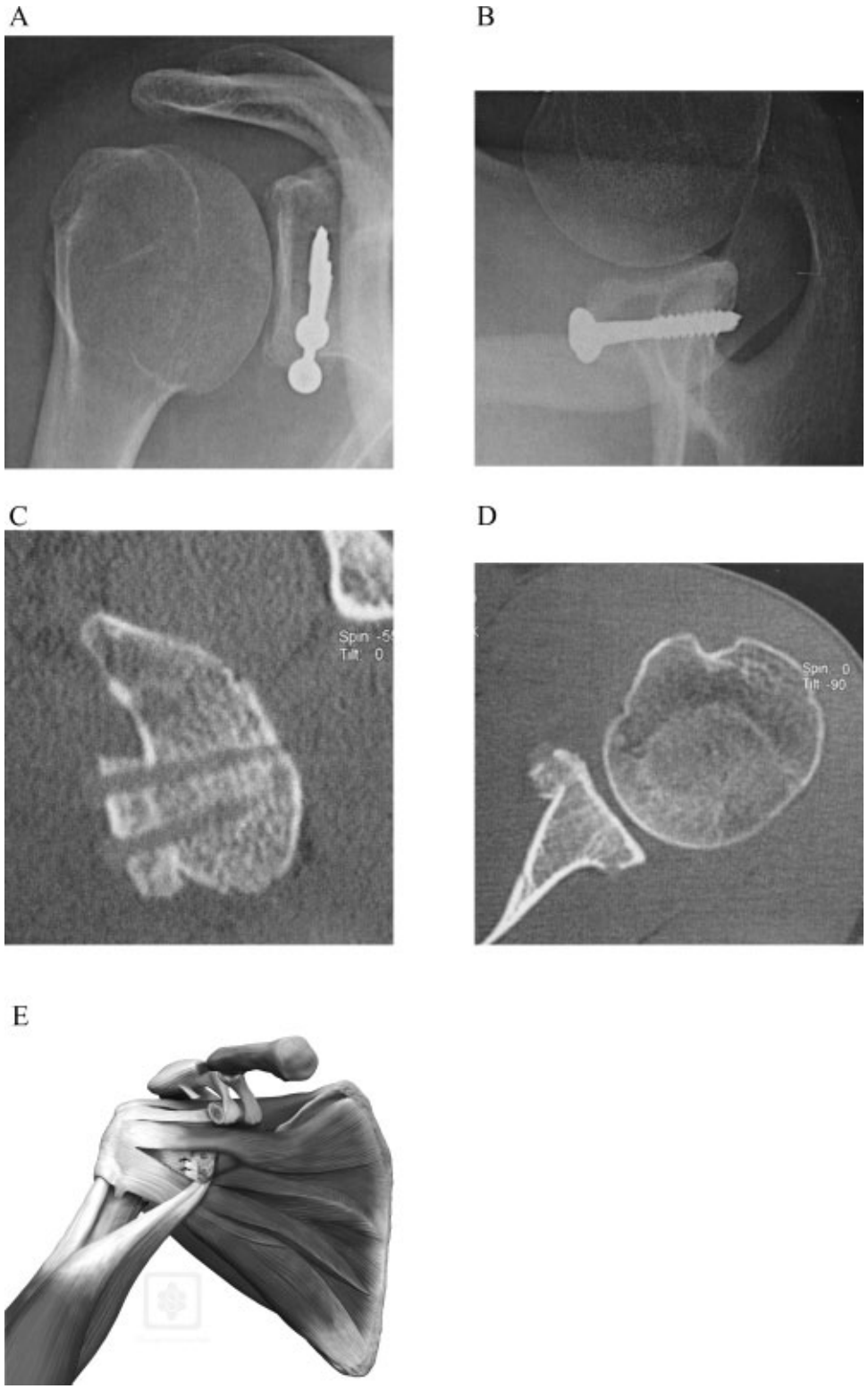

Fig. 5. A–E: Latarjet and principle of action.
A-D: Radiographs and CT showing a united Latarjet procedure and the "bony effect" of the procedure E: The coracoid graft positioned with capsular repair, demonstrating the "sling effect" via the conjoint tendon and subscapularis as well as the "capsule effect" via repair of the capsule to the graft.

The better visualisation and limited soft tissue compromise made the procedure well suited to arthroscopic surgery. However early arthroscopic techniques had a high failure rate compared to open repairs.[62,63] Technological advancements have facilitated stronger and more anatomical repairs with suture anchors and now show comparable results to open repairs in most series.[64,65]

Risk factors for failure of an arthroscopic Bankart repair include male patients, age less than 22, more than 3 previous dislocations, surgery performed in the beach chair position compared to lateral decubitus, use of less than 3 suture anchors and engaging Hill Sachs lesions or significant glenoid bone loss.[65–71] Balg and Boileau tried to aide surgical decision making with the Instability Severity Index Score, or ISIS.[72] By assigning points based on the patient's age, degree and type of sport participation, hyperlaxity and glenoid bone loss or humeral head defect, they found a score of 6 or less led to recurrence rates of 10% with scores of more than 6 leading to recurrence rates of greater than 70%. They concluded that patients with an ISIS score of greater than 6 are better managed with the Latarjet procedure. However, a follow-up study was not able to confirm its accuracy in detecting failure of arthroscopic Bankart repairs.[73]

In a comparison between contact and collision athletes who underwent arthroscopic stabilisation after the first shoulder dislocation Ranalletta et al found a 0% recurrence rate at 2 years for the contact group, but a 14.7% recurrence in the collision group, made up primarily of rugby players. Cho et al also found a recurrence rate of 28.6% in collision athletes compared to 6.7% in the non-collision group.[74] They also found that contact athletes returned to sport quicker and with more returning to their pre-injury athletic level compared to collision athletes.[75] The difference in specific sports is also shown in the adolescent population, where a study of contact and collision athletes, not including rugby, had a recurrence rate of 10.3% at over 6 years follow-up,[76] whereas a series of primarily adolescent rugby players found a recurrence rate of 31% at 4 years.[77] Another series found a 21% recurrence in contact and overhead adolescent patients at 5 years follow-up.[78]

Glenoid bone loss has been repeatedly shown to be associated with high recurrence rates after arthroscopic Bankart repairs. De Beer and Burkhart found that in their patients with bone loss >25% they had a recurrence rate of 67%, and 89% in contact athletes, with an arthroscopic Bankart repair compared to 4.9% with an open Latarjet procedure.[19,23] Glenoid bone loss has been shown to be more common in patients with recurrent dislocations and in those who have their first dislocation at a younger age.[18] Different contact sports may also tolerate different amounts of bone loss, with Nakagawa et al finding rugby athletes had a high recurrence rates after arthroscopic Bankart repairs with any bone loss, whereas other contact and collision athletes they could tolerate 10% bone loss before the recurrence rate significantly increased.[79]

6.2.2. Bone procedures – Latarjet, Bristow and variants

Anterior glenoid bone block procedures have been shown to have a low recurrence rates in contact and collision athletes, including rugby.[80–82] The most commonly used is the Latarjet coracoid transfer but similar procedures such as the Bristow (coracoid tip) or Eden-Hybinette (iliac crest graft) are also used with good results. Anterior glenoid bone blocks have been shown to be effective in the setting of glenoid bone loss and Hill Sachs lesions by Burkhart and De Beer.[23] The "triple blocking effect" and the biomechanics of the Latarjet have been described in detail[83,84] (Fig. 5). The Latarjet being found to be superior to the Bristow in the setting of glenoid bone loss[85] as well as being effective in the management of Hill Sachs lesions.[86] A recent meta-analysis comparing the bone block procedures to an arthroscopic Bankart repair found a significantly lower recurrence, 11.6% compared to 21%, and redislocation rate, 9.5% for Bankart procedures compared to 5% with the bone block procedures.[87] Whilst another review of the published Latarjet results found a repeat subluxation or dislocation occurring in 7.5% of patients, with a reported range of 0–19.1%.[80] In our own group of contact athletes we found a recurrence rate of 3% and return to sport of >95% treated with the Latarjet.[88]

There have been concerns raised by the high number of complications associated with these procedures in some studies,[89,90] however this has not been borne out in all review articles.[80] Indications, patient selections and surgical techniques have been discussed in various articles, aimed at decreasing the complication rate and improving outcomes for the open Latarjet procedure.[91,92] Graft malposition is also a key step at avoiding complications, with grafts positioned too medial leading to higher redislocation rates and too lateral leading to glenohumeral arthropathy.[93,94]

6.2.3. Other procedures

There has been an increase in the interest in the management of the Hill Sachs lesion, and especially "off track" lesion, in the humeral head.[95,96] Whilst the Latarjet has been used for this lesion, other options include allograft reconstruction, partial resurfacing arthroplasty, hemiarthroplasty or remplissage.[97] Giacomo has proposed that patients with "off track" lesions and no bone loss should be treated by a remplissage,[96] however the role of this in the contact athlete is unclear.

Other injuries that may need to be assessed include a humeral avulsion of the glenohumeral ligament, or HAGL, which may be anterior or posterior, as well as capsular ruptures and tears. HAGL's have been reported to have high recurrence rates with non-operative treatment but can be successfully treated by both open and arthroscopic techniques.[98,99] With capsular tears however, some authors have found high recurrence rates even with arthroscopic repair, leading to concerns about the best way to treat these lesions.[100]

Rotator cuff tears can also occur in the setting of shoulder instability, and they always require surgical repair. Some surgeons report good results with a two-staged procedure to address the pathology, with the rotator cuff treated first and the instability addressed at a later stage.[101] Others have managed to treat the patient's instability with an arthroscopic Bankart repair to allow them to return to sport and performed a rotator cuff tear in the off-season.[102] We prefer to address both pathologies at the same time, to minimise the time off sport and aide recovery.

7. Summary

Anterior shoulder instability is a complex issue in the contact and collision athlete that requires an individualised approach, taking into account the patients, level and type of sport, time of the season and structural injuries around the shoulder. of choice as well as assessing their risk of recurrence is vital to ensure the correct management decision is made. Surgery should address all the relevant pathologies. This approach, with multidisciplinary input, is vital to ensure the correct management decision is made to ensure a safe return to sport and minimise the risk of recurrence and complications.

Conflict of interest

Dr. Mattern has nothing to disclose.

Dr. Funk has nothing to disclose.

Dr. walton reports personal fees from Arthrex, personal fees from LIMA, personal fees from Medarits, outside the submitted work.

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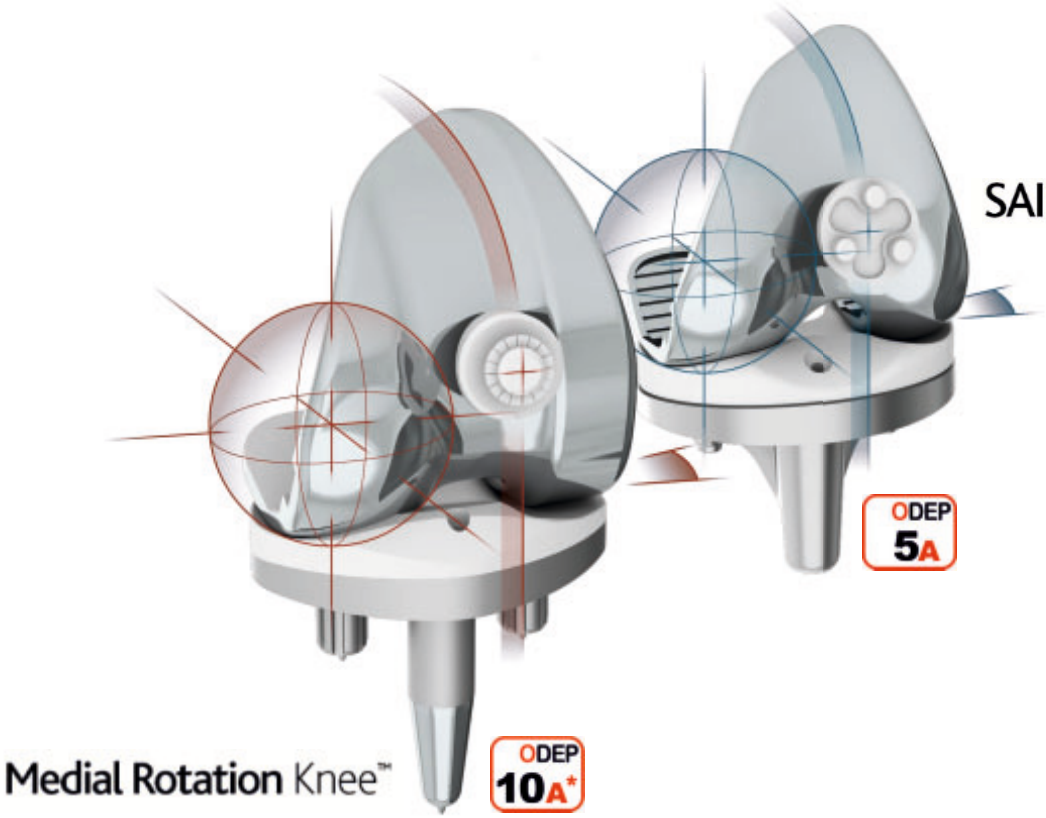

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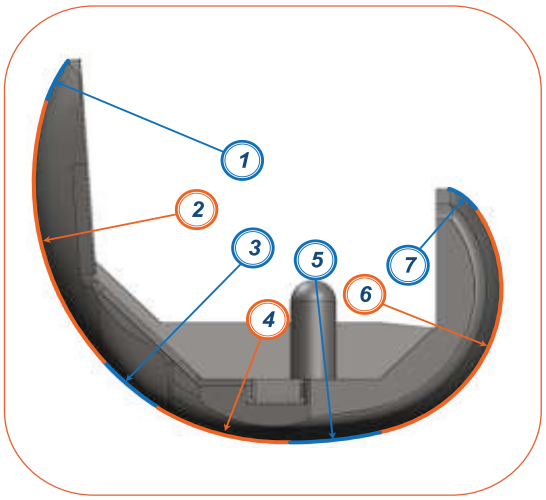

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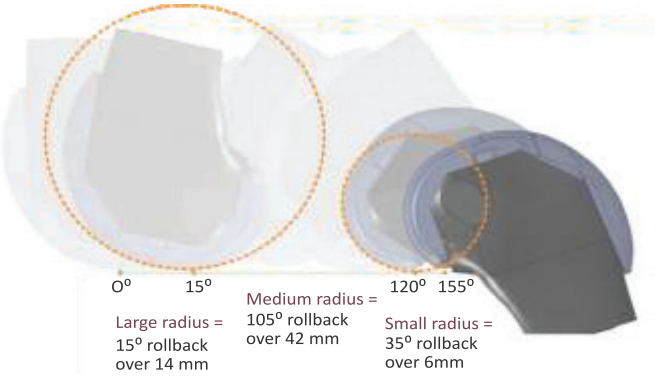

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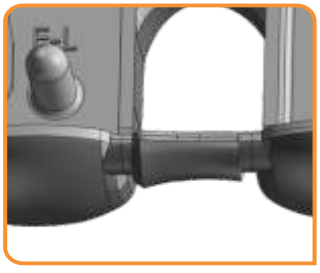

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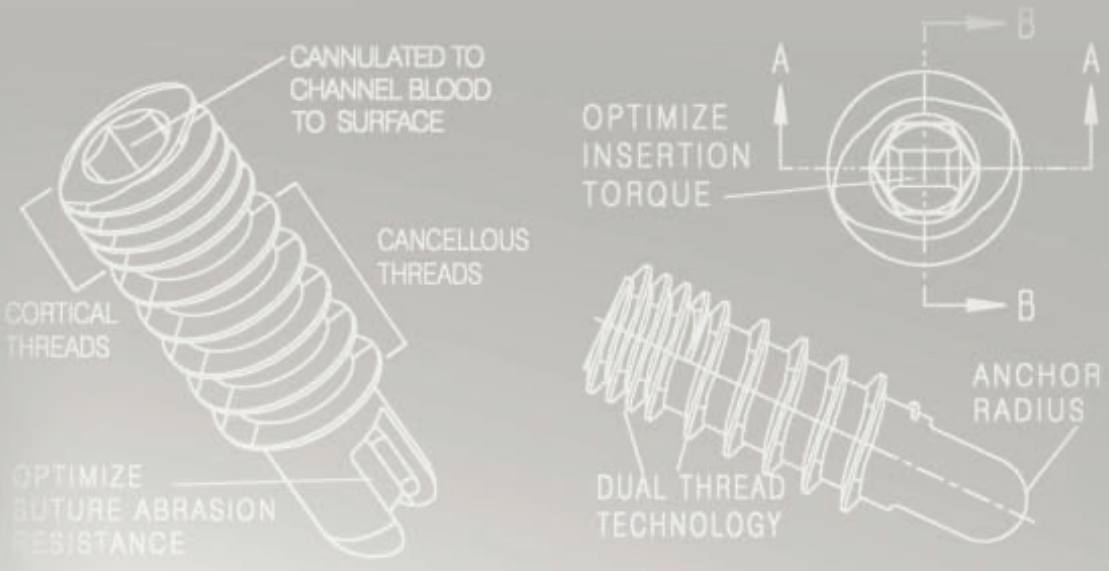

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