

Arthroscopic Reduction and Stable Fixation of an Anterior Glenoid Fracture With 4 Buttons



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Abstract: An arthroscopic technique for the reduction and stable fixation of an articular glenoid fracture with a 2-button compression system, originally designed for the treatment of shoulder instability with bone deficiency in the anterior glenoid, is presented. This technique allows direct visualization of the joint, reduction of the fracture, precise placement of the buttons according to the fracture line, and stable fixation. It is a safe and reproducible technique, using the standard shoulder arthroscopy portals.

Fractures of the scapula are rare, and most cases are treated in an orthopaedic manner. The scapula is a very well-vascularized bone owing to the numerous muscles attached to it. As a result, it almost always becomes consolidated. Indications for surgically treating these fractures include the existence of a glenoid articular fracture with displacement greater than 2 mm¹ or 5 mm.² In addition, when there are associated fractures of the shoulder suspensory complex, it is recommended that some of the fractures be fixed to restore stability to the complex.³

In the case of a scapular fracture with a displaced articular line but in which the rest of the scapula has acceptable midlateral displacement (20 mm) and an acceptable angle (25°),⁴⁻⁷ the articular fragment may be treated surgically to achieve anatomic reduction and stable fixation. The other scapular fragments that are not part of the glenoid cavity are left unreduced and unfixed.

Various open techniques have been described for treating displaced articular glenoid fractures that require this kind of approach, with both intraoperative

and postoperative risks.^{8,9} Several arthroscopic techniques also have been described for reducing and fixing fractures with screws through anterior portals, crossing the subscapularis and involving the corresponding neurovascular risks.^{10,11} Others include the use of instability anchors placed in the main glenoid fragment, crossing the displaced fragment with the sutures, so that when knotting is performed, the fracture is reduced and stabilized. This technique, using implants, is more suitable for cases involving smaller glenoid fragments in which the capsulolabral complex is intact.¹¹⁻¹⁵ In cases with larger fragments or with damage to the



Fig 1. Anteroposterior radiograph of scapular and clavicular fracture in patient with old consolidated distal-third clavicular fracture. This is an articular glenoid fracture, with a large anterior fragment displaced more than 5 mm (Ideberg type 1).

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Fig 2. Computed tomography (CT) scan showing articular fracture of glenoid. A CT scan is mandatory in the case of a glenoid articular fracture to study the articular surface and decide whether treatment should be performed surgically. In this case, a CT scan is necessary to prepare for the surgical procedure and study where to place the buttons and how many are needed to reduce and stabilize the fracture.

capsulolabral complex, more stable fixation is recommended because this allows greater interfragmentary compression, enabling fracture

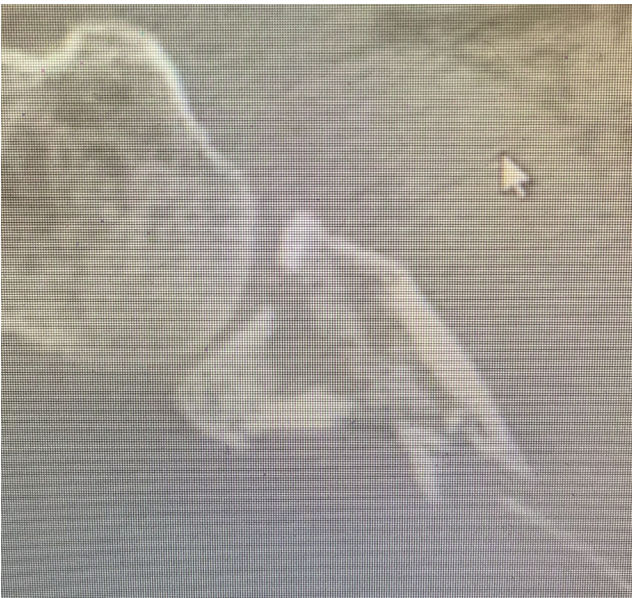


Fig 3. Computed tomography scan showing articular fracture of glenoid. This scan is mandatory to prepare for the surgical procedure and study where to place the buttons and how many are needed to reduce and stabilize the fracture. In this image, the rest of the scapular fracture can be visualized to decide whether nonsurgical treatment is suitable.



Fig 4. One-hole specific guide (Double Round EndoButton) designed for arthroscopic treatment of anterior shoulder instability with bone deficit. This is the guide that is used in this surgery because allows to put one or two EndoButtons depends on the size of the fragment and in case of using two EndoButtons, this guide allows to choose the distance and orientation of the buttons depending on the type of fracture.

reduction and consolidation in the anatomic position and early mobilization of the shoulder to avoid complications. Arthroscopic fixation of large anterior glenoid fractures (Ideberg type 1)¹⁶ using interfragmentary compression systems, originally designed for treating shoulder instability with bone deficit to add and fix bone grafts, has already been described by several authors.¹⁷⁻²¹

Indications and Preoperative Planning

As already mentioned, a scapular fracture with a displaced articular line but in which the rest of the scapula has acceptable displacement can be treated by just reducing and fixing the articular part of the fracture. A computed tomography (CT) scan is mandatory to study the articular fracture of the glenoid, to prepare for the surgical procedure, and to plan where to place



Fig 5. One-hole specific guide (Double Round EndoButton) designed for arthroscopic treatment of anterior shoulder instability with bone deficit. This is the guide that is used in this surgery because allows to put one or two EndoButtons depends on the size of the fragment and in case of using two EndoButtons, this guide allows to choose the distance and orientation of the buttons depending on the type of fracture.

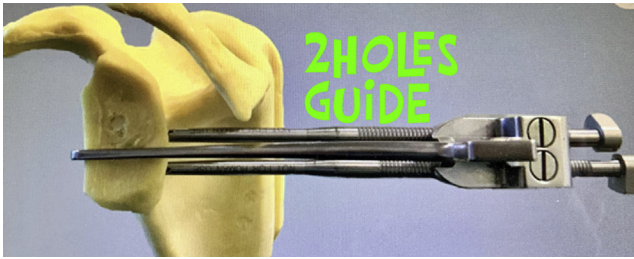


Fig 6. Two-hole specific guide (Double Round EndoButton) designed for arthroscopic treatment of anterior shoulder instability with bone deficit. This guide has 2 holes separated by 1 cm; the distance between the holes is a fixed distance. This guide is usually used for bone-block surgery because a well-prepared and customized bone graft is used and 2 buttons separated by 1 cm are used to fix and compress the bone graft, unlike a fracture case in which the fracture type and fragments cannot be changed or customized.

the buttons and how many are needed to reduce and stabilize the fracture (Figs 1-3).

Specific Device for Surgery

As already mentioned, this technique uses specific instruments designed for the arthroscopic treatment of anterior shoulder instability with bone deficit^{22,23} (Double Round EndoButton; Smith & Nephew, Andover, MA). With these specific instruments being taken into account, 2 types of guides are available to perform bone-block procedures: a guide with a single hole (Figs 4 and 5) and a guide with 2 holes separated by 1 cm. We usually use the latter guide for bone-block surgery (Fig 6) because a well-prepared bone graft of 2.5 cm in length is used, and 2 buttons separated by 1 cm are used to fix and compress the bone graft.



Fig 7. Arthroscopic view of shoulder with scope in standard posterior portal and Wissinger rod through standard anterior portal, with patient in lateral decubitus position. The articular glenoid fracture, with a large anterior fragment displaced more than 5 mm (Ideberg type 1), can be observed and assessed; the hematoma is cleaned, the fragments are mobilized, and the fracture reduction is assessed.

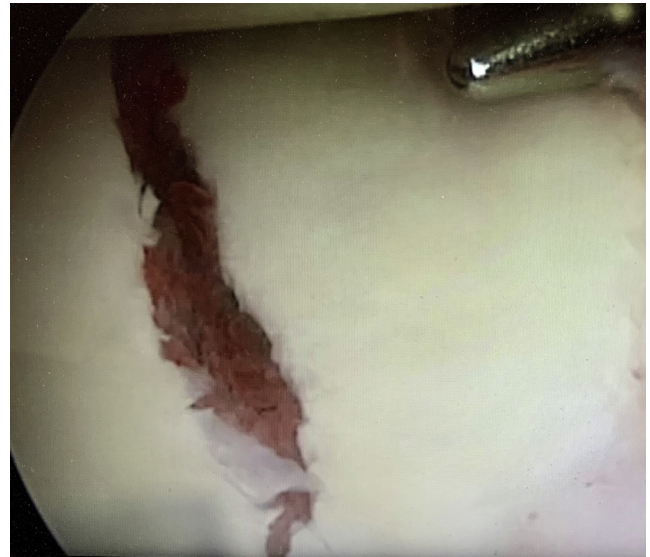


Fig 8. Arthroscopic view of shoulder with scope in anterosuperior portal and Wissinger rod through posterior portal, with patient in lateral decubitus position. The articular glenoid fracture, with a large anterior fragment displaced more than 5 mm, can be observed and assessed; the hematoma is cleaned, the fragments are mobilized, and the fracture reduction is assessed. The scope is maintained in this portal during most of the surgical procedure.

However, in the case of glenoid fractures, using a guide with only 1 hole gives us the freedom to configure the placement of the implants according to each fracture, depending on the size of the fragment and the orientation of the fracture trace. The system allows a high degree of interfragmentary compression, increasing stability and favoring fracture consolidation.



Fig 9. Arthroscopic view of shoulder with scope in anterosuperior portal, with patient in lateral decubitus position. The 1-hole specific guide (described in Figs 4 and 5) is entering parallel to the articular surface of the glenoid cavity through the posterior portal. The tip of the hook of the guide has to reach the anterior part of the cortex of the anterior glenoid fragment. A guide needle is passed through the bullet in the guide from the posterior of the glenoid cavity to the anterior fragment.



Fig 10. Arthroscopic view of shoulder with scope in anterosuperior portal, with patient in lateral decubitus position. The 1-hole specific guide (described in Figs 4 and 5) is entering parallel to the articular surface of the glenoid cavity through the posterior portal. The tip of the hook of the guide has to reach the anterior part of the cortex of the anterior glenoid fragment. A guide needle is passed through the bullet in the guide from the posterior of the glenoid cavity to the anterior fragment.

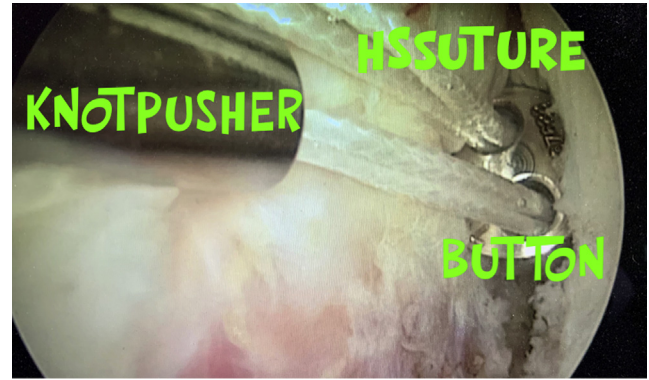


Fig 12. Arthroscopic view of shoulder with scope in anterosuperior portal, with patient in lateral decubitus position. The second button is placed on the high-strength (HS) sutures, and a sliding, self-locking knot is made and is pushed down with the knot pusher, taking the second button to the anterior cortex of the anterior glenoid fragment. This compresses the fracture and locks the knot.

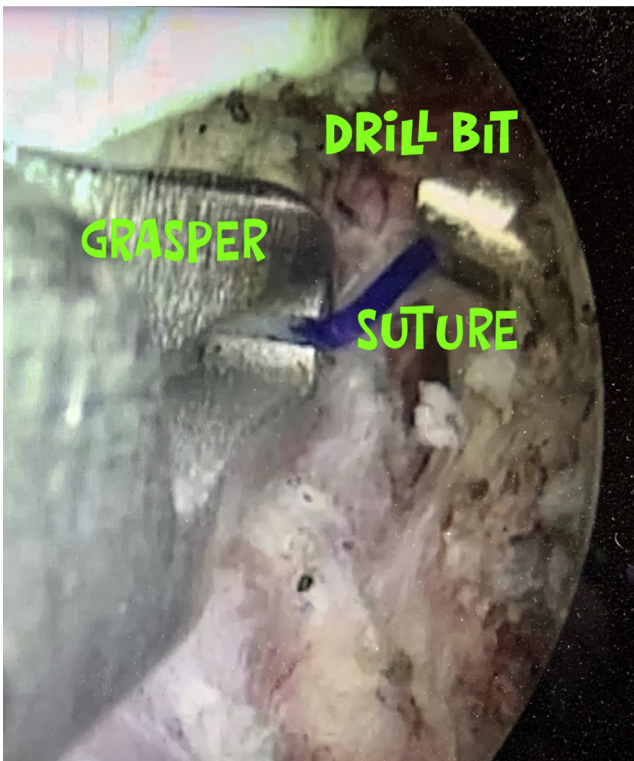


Fig 11. Arthroscopic view of shoulder with scope in anterosuperior portal, with patient in lateral decubitus position. A cannulated drill bit is inserted from the posterior glenoid cortex to the anterior cortex of the anterior fragment; a carrier suture is passed through the hole in the drill bit, and a grasper through the anterior portal is used to catch the carrier suture and retrieve it. This carrier suture will be used to pass the sutures of the EndoButtons from posterior to anterior, with the first button remaining on the posterior cortex of the glenoid cavity and the high-strength sutures exiting through the anterior portal.

Table 1. Pearls and Pitfalls of Arthroscopic Management of Articular Glenoid Fracture

Pearls

A preoperative CT scan should be obtained to study the fracture. Placing the patient in the lateral decubitus position with traction produces ligamentotaxis and improves the alignment of the fragments using the surrounding intact soft tissues. In the first phase of surgery, it is important to wash the hematoma, mobilize the fragments, and assess the fracture reduction. The surgeon should ensure that the guide enters through the posterior portal parallel to the articular surface of the glenoid cavity. It might be necessary to create another posterior portal. A periosteal elevator or Wissinger rod through the anterior portal should be used to mobilize and reduce the fracture. With the hook of the guide resting on the anterior fragment of the glenoid fracture, the surgeon should pull the guide from anterior to posterior to achieve compression of the fracture. The cannulated drill bits should be kept in position until button placement to maintain fracture reduction.

Pitfalls

The surgeon should be very careful when handling the fragment to avoid the risk of breaking or devitalizing it. The drill holes should not be made too close to the articular edge of the fragment to prevent it from breaking. The guide should not be rotated because the drill holes in the fragment will not be at the same height and will cause shear instead of compression forces that will displace the fracture. If the guide does not run parallel to the articular surface of the glenoid, another posterior portal must be created to introduce the guide. The anterior fragment should not be overly compressed to avoid fracture or collapse of the fragment. This can be controlled with the scope in the anterosuperior portal and direct visualization of the fracture. Drill holes should not be made in the case of an unreduced fracture. If there is a large anterior glenoid fragment, it is better to use 2 EndoButtons; if it is too small, only 1 EndoButton should be used.

CT, computed tomography.



Fig 13. Arthroscopic view of shoulder with scope in anterosuperior portal, with patient in lateral decubitus position. The reduction and stability of the fracture are assessed after compression and fixation with 2 EndoButtons. A Wissinger rod through the posterior portal is used to assess the reduction of the articular surface and stability after compression with 2 EndoButtons.

Patient Setup

The intervention is performed with the patient in the lateral decubitus position, under plexal and general anesthesia. The arm is placed with 5 kg of traction in 20° of anterior flexion and 60° of abduction. Shoulder arthroscopy is performed, with the scope initially in the standard posterior portal to assess the fracture (Fig 7, Video 1). Subsequently, the standard anterior and anterosuperior portals are created. In the first phase of surgery, the hematoma is washed, the fragments are mobilized, and the fracture reduction is assessed (Fig 8).

With the scope in the anterosuperior portal, entering through the posterior portal, a special guide is placed that enters parallel to the articular surface of the glenoid cavity and that reaches the anterior cortex of the



Fig 14. Arthroscopic view of shoulder with scope in anterosuperior portal, with patient in lateral decubitus position. The reduction and stability of the fracture are assessed after compression and fixation with 2 EndoButtons. A Wissinger rod through the posterior portal is used to assess the reduction of the articular surface and stability after compression with 2 EndoButtons.



Fig 15. A control radiograph is obtained the day after the surgical procedure to verify the correct reduction of the fracture and the correct and symmetrical position of the anterior and posterior buttons. The clinical progression is excellent.

anterior glenoid fragment (Figs 9 and 10). Then, a bullet is placed through the guide hole until contact is made with the posterior glenoid. The fracture reduction is evaluated, and with the hook of the guide supported on the anterior fragment, the reduction is maintained.



Fig 16. A control computed tomography (CT) scan is performed 4 months after the surgical procedure to verify complete scapular fracture consolidation and anatomic reduction and consolidation of the articular surface. One can also verify that the buttons are correctly positioned, far from the articular surface, to avoid chondral damage.



Fig 17. A control computed tomography (CT) scan is performed 4 months after the surgical procedure to verify complete scapular fracture consolidation and anatomic reduction and consolidation of the articular surface. One can also verify that the buttons are correctly positioned, far from the articular surface, to avoid chondral damage.

A guide needle is passed through the bullet in the guide from the posterior of the glenoid cavity to the anterior fragment. A cannulated drill bit is inserted, and a carrier suture is passed through the hole in the drill bit (Fig 11). This is then used to move an EndoButton that holds high-strength suture from the posterior to anterior position. This process is repeated to place another, lower EndoButton, thus achieving more stable fracture fixation.

By use of a carrier suture, the sutures of the EndoButtons are passed from posterior to anterior, with the first button remaining on the posterior cortex of the glenoid cavity, and the high-strength sutures exit through the anterior portal. The second button is placed on the high-strength sutures, and a sliding, self-locking knot is made and is pushed down, taking the second button to the anterior cortex of the anterior glenoid fragment (Fig 12). This compresses the fracture and locks the knot. The same procedure is then performed with the second, lower EndoButton, achieving stable fixation with 2 EndoButtons (4 buttons total, 2 anterior and 2 posterior) that provide interfragmentary compression. It is not necessary to manipulate the capsulolabral complex using this technique (Table 1). The reduction and stability of the fracture are evaluated (Figs 13 and 14).

Postoperative Management

A control radiograph is made the day after the operation (Fig 15). A sling is placed on the patient. It can be

removed, even from the first day, for eating and personal hygiene reasons. The patient may carry out his or her daily activities with the arm below head level and without taking any weight. From the first week, the patient begins self-assisted anterior elevation shoulder exercises, with the only restriction being pain. From the third week onward, active exercises are started without restriction in terms of degrees of mobility. At 2 months, rotator cuff–strengthening exercises and shoulder-stretching exercises commence, and weight bearing is allowed progressively. A control CT scan is performed after 4 months to evaluate fracture consolidation (Figs 16 and 17).

Discussion

The goal when treating a joint fracture is to achieve an anatomic reduction and stable fixation that allow early mobility and prevent the appearance of stiffness and post-traumatic osteoarthritis. This principle also applies to glenoid fractures. Multiple techniques have been described for treating articular glenoid fractures, but there is no clear gold standard. The use of arthroscopy for treating articular fractures is becoming more frequent and is being applied in an increasing number of locations (wrist, knee, and ankle), including in the treatment of glenoid fractures, and various arthroscopic techniques have been published on this treatment.

Table 2. Advantages and Disadvantages of Arthroscopic Management of Articular Glenoid Fracture

Advantages	
The surgical procedure is minimally invasive, with all the advantages thereof.	
Diagnosis, evaluation, and assessment of possible associated injuries can be performed.	
The surgical procedure can be performed with standard shoulder arthroscopy portals, being a more “familiar” surgical procedure without risky and less common anteromedial portals.	
Direct visualization and control of fracture reduction and stabilization are possible.	
Direct manipulation of the fragments can be performed to obtain anatomic reduction.	
By use of the 1-hole guide, the buttons can be placed according to the type of fracture and the size and orientation of the fragments.	
The system achieves great interfragmentary compression and great stability.	
Metallic screws are not used, avoiding the risks of placing metallic implants close to the joint.	
Revision surgery can be easily performed because the anatomic planes are not altered in this surgical procedure.	
Disadvantages	
The technique is technically demanding.	
Specific devices and instrumentation are needed.	
This surgical procedure has a high price compared with fixation with 2 metallic screws.	
The indications for the technique only include acute cases and fractures with fragments ≥ 1 cm in size.	

The technique presented in this article has certain advantages: It is a safe technique that uses the standard portals for shoulder arthroscopy, without the need to use anterior portals, which carry a neurovascular risk, or to cross and damage the subscapularis tendon. In addition, it allows direct control of the fracture reduction at the joint, enables anatomic reduction and stable fixation without using metal screws near the joint, and avoids the risk of any complications owing to the use of osteosynthetic material. The specific guide is very precise and allows the implants to be placed in the desired area according to the type of fracture (Table 2).

Two types of guides to perform bone-block surgery have been described for treating shoulder instability with bone deficit to add and fix bone grafts: a guide with a single hole and a guide with 2 holes separated by 1 cm. We usually use the latter guide for this surgical procedure because a well-prepared bone graft of 2.5 cm in length is used and 2 buttons separated by 1 cm are used to fix and compress the bone graft. In the case of glenoid fractures, using a guide with only 1 hole gives us the freedom to configure the placement of the implants according to each fracture, depending on the size of the fragment and the orientation of the fracture trace. The system permits a high degree of interfragmentary compression, increasing stability and favoring fracture consolidation.

As recommended by Avramidis et al.,¹⁸ the described technique is indicated for acute fractures, as well as fractures with fragments larger than 1 cm. Although other articles detailing similar arthroscopic techniques have been published for treating fractures of the anterior glenoid rim, the described technique offers important features such as the use of 2 independently placed implants, knotting in the anterior part of the glenoid with direct visual control of the implant at all times, and knotting and reduction of the fracture. It also adds CT control of fracture healing and clinical monitoring of the patient's progress.

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