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MANEJO DE LA ROTURA IRREPARABLE POSTEROSUPERIOR SIN ARTROPLASTIA

¿Por qué fracasa la SCR?

OPCIONES DE TRATAMIENTO

Rotura masiva



- Desbridamiento y DSA
- Reparación parcial.
- Tenotomía de PLB.
- RCS con bíceps.
- Liberación del nervio supraescapular.
- **TRANSFERENCIAS TENDINOSAS**
 - Transposición dorsal ancho.
 - Transposición Trapecio Inferior.
- **ARTROPLASTIAS**
 - Prótesis inversa
- **PARCHES E INJERTOS.**
 - Reconstrucción capsular superior (RCS).

CAPSULA SUPERIOR

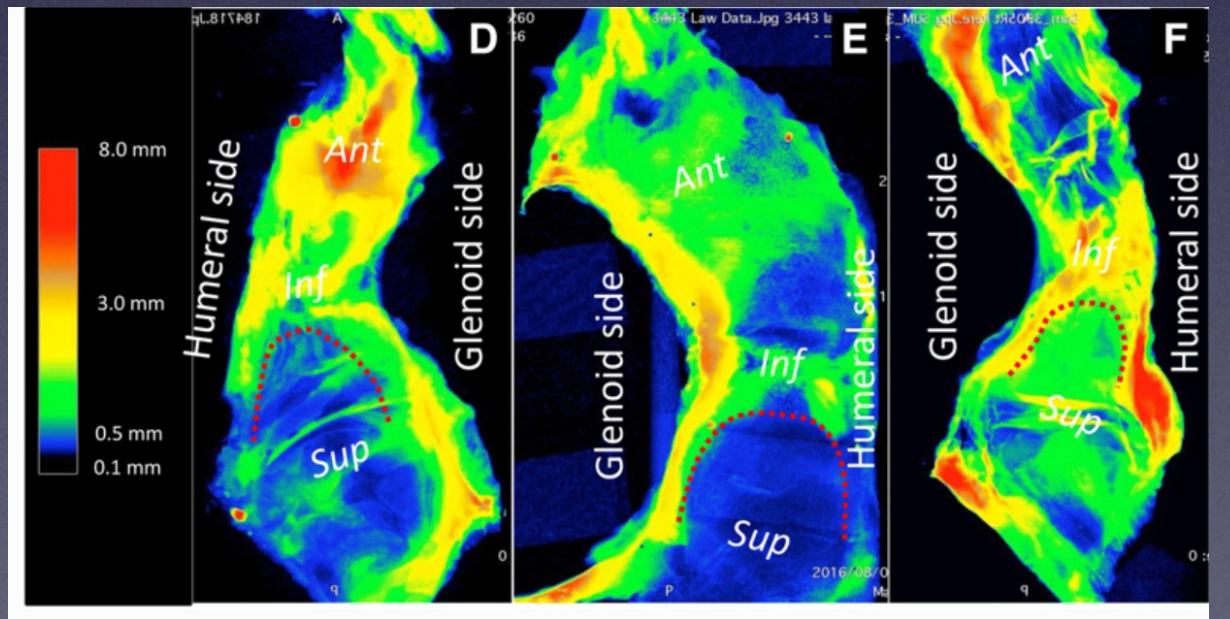
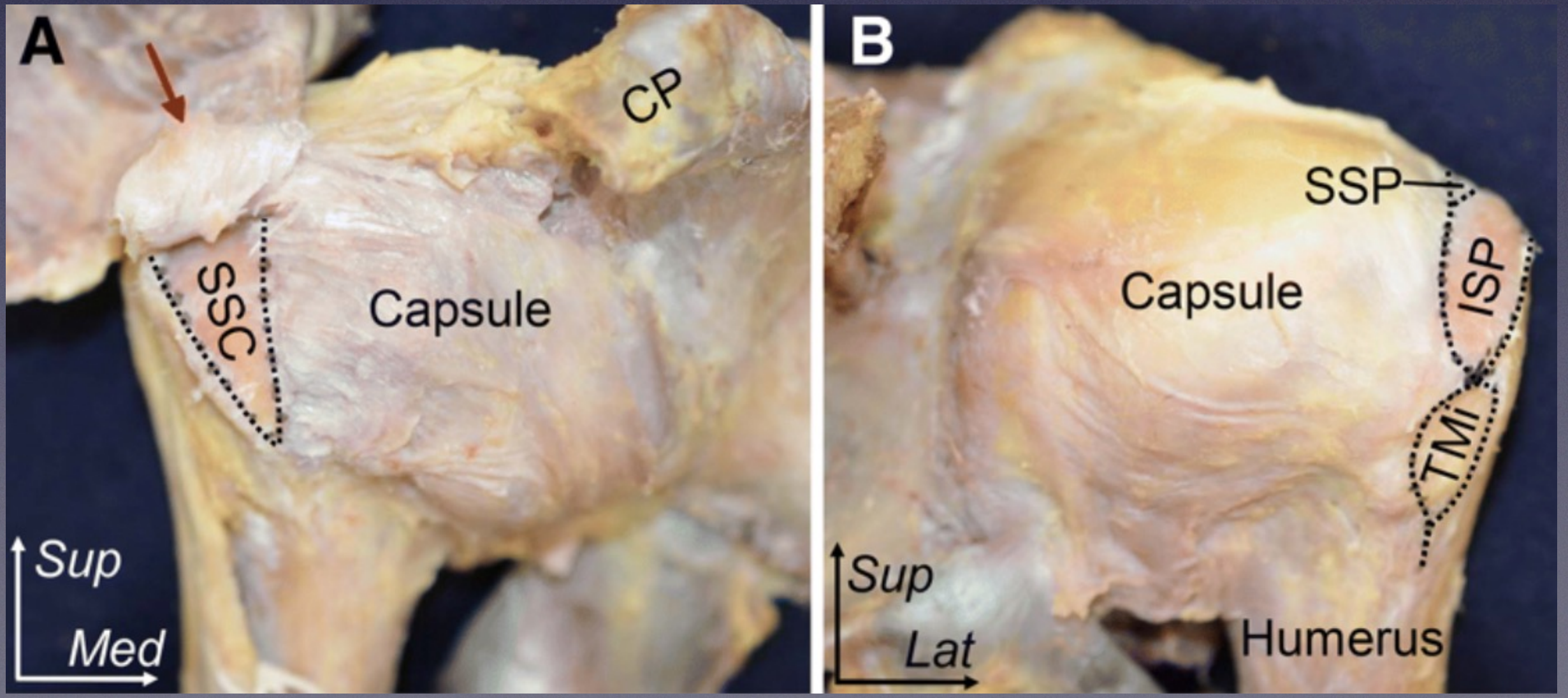
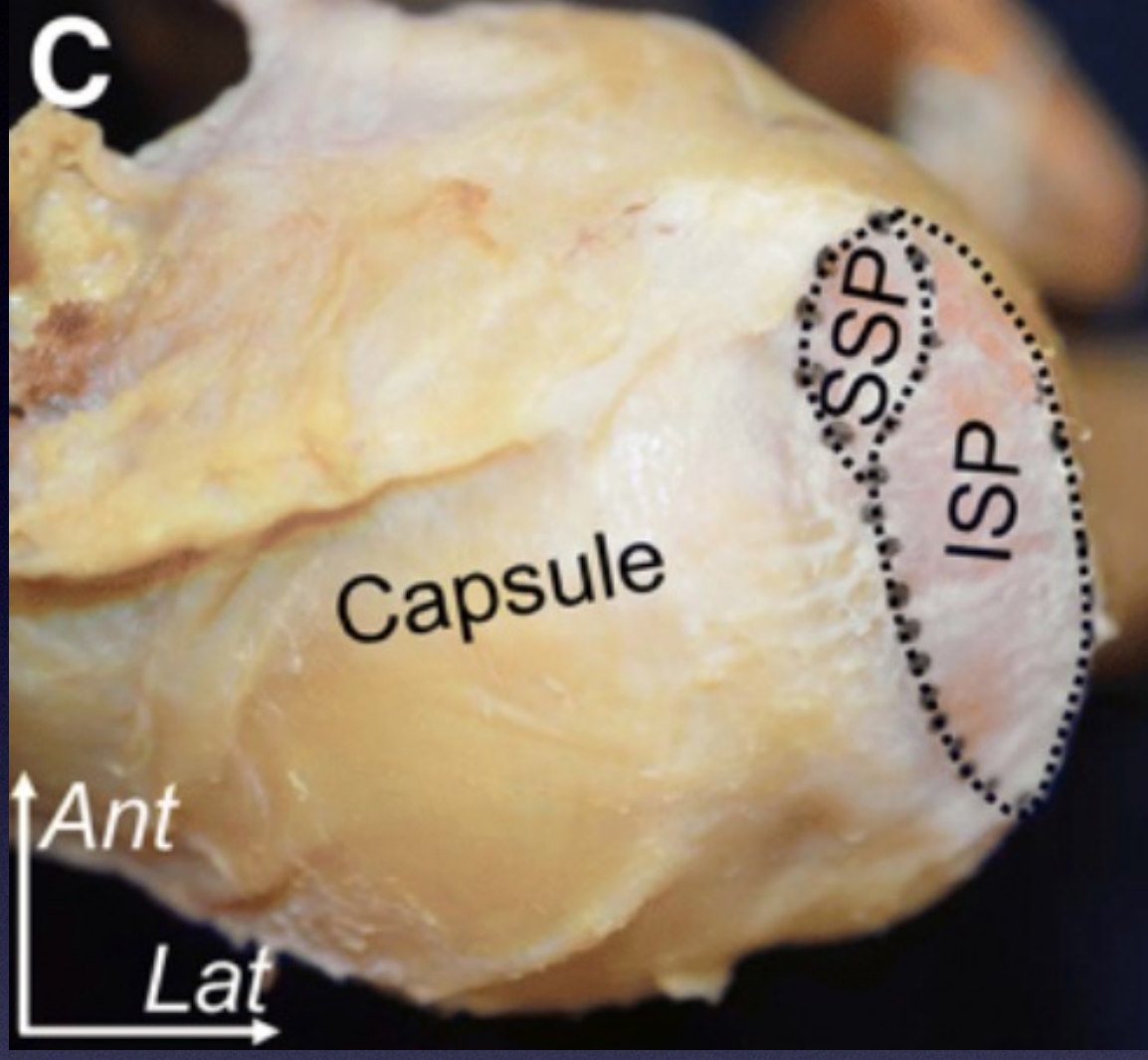
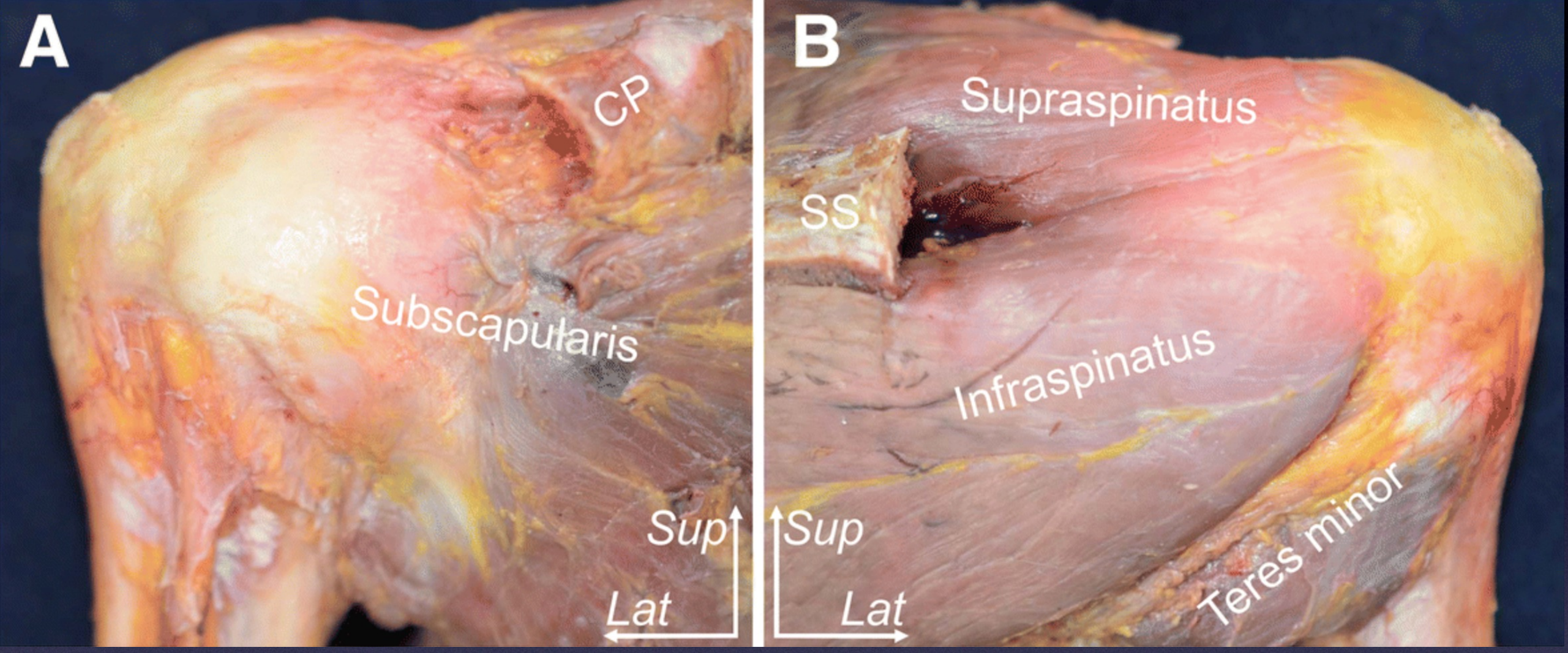
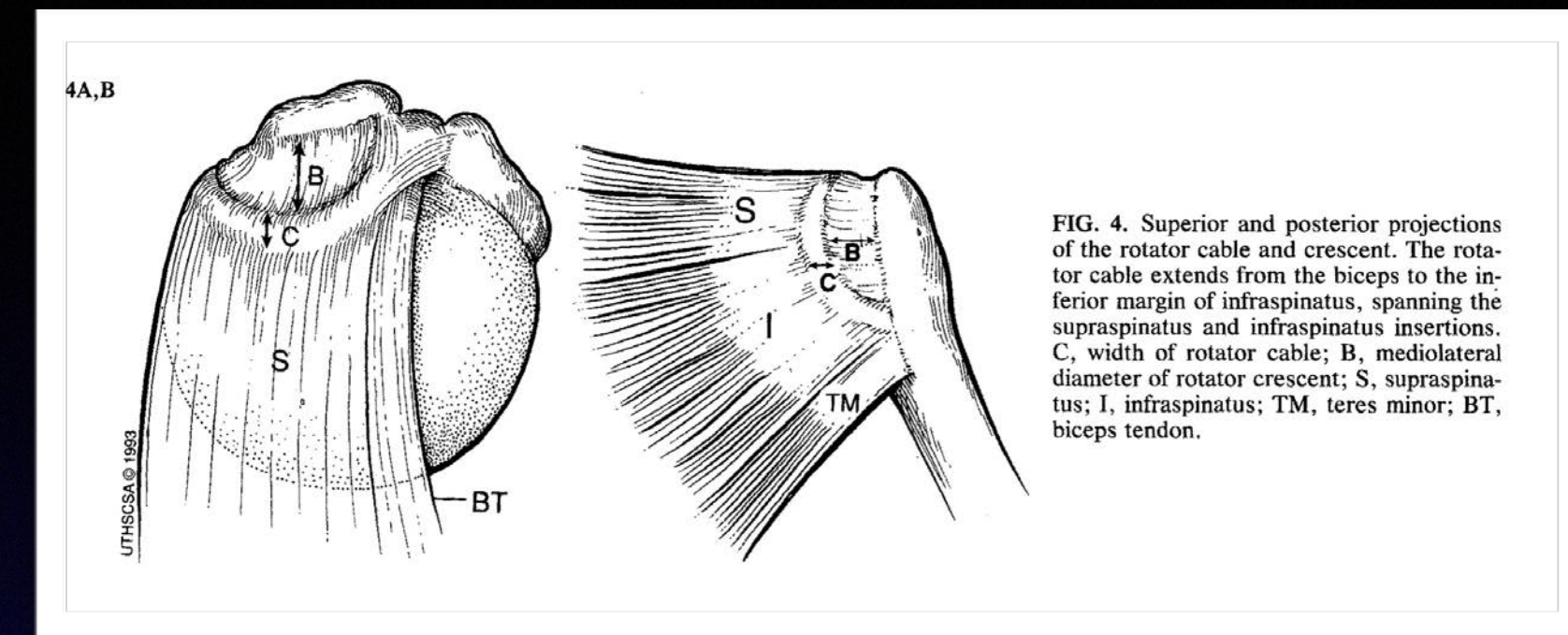


Fig. 7
Variations in capsular thickness distribution. The remaining data, except for that in Fig. 6, is shown in the present figure. Inside appearances of the whole capsule (a, b, and c) corresponds to 3D images with micro-CT (d, e, and f), respectively. The color bar represents approximate thickness (mm) corresponding to the colors. Inferior parts of the capsule, colored red, yellow, and green, were consistently thicker than the superior part, colored green, blue, black. However, the anterior part seemed variable in comparison with the inferior part. In addition, the thick inferior part of the capsule continued to the superior area along the glenoid and humeral side edge (red dotted lines in d, e, and f). Ant, anterior; Inf, inferior; Sup, superior

CAPSULA ESTABILIZADOR ESTATICO CLAVE



Arthroscopic Superior Capsular Reconstruction for Treatment of Massive Irreparable Rotator Cuff Tears

Alan M. Hirahara, M.D., F.R.C.S.C., and Christopher R. Adams, M.D.

Abstract: Massive irreparable rotator cuff tears have been troublesome entities to treat, especially in younger patients. Few good options exist, leaving most patients in recent years receiving a reverse total shoulder arthroplasty. Reverse shoulder arthroplasty carries serious risks, a limited lifespan, and no other viable options should it fail. Recent biomechanical studies have shown that the superior capsule is critical to containing the glenohumeral joint reduced, allowing the larger muscles like the deltoid and pectoralis major to function properly. The superior capsular reconstruction is an anatomic reconstruction of the superior capsule to restore the normal restraint to superior translation that occurs with a deficient rotator cuff. The technique described in this article is an arthroscopic reconstruction of the superior capsule with dermal allograft.

The treatment of massive irreparable rotator cuff tears presents a significant challenge to health care providers. Options range from nonoperative care to operative debridement and biceps tenotomy,^{1,2} partial repair of the rotator cuff,³⁻⁷ bridging patch grafts,⁷ muscle transfers,⁸⁻¹¹ and reverse total shoulder arthroplasty. However, the results of such treatments are often mixed with a significant risk of complications. The superior capsular reconstruction (SCR) was originally described as an alternative to the aforementioned procedures.¹¹ In the original description, autograft fascia lata was harvested from the patient's thigh and was secured from the glenoid to the greater tuberosity. This restored the normal superior restraint to proximal migration of the humeral head and in several cases resulted in reversal of pseudoparalysis.¹² The original biomechanical and preliminary clinical results are quite promising. The technique described in this article is an arthroscopic reconstruction of the superior capsule with dermal allograft.

Operative Technique

The indications for an arthroscopic SCR are a massive irreparable supraspinatus and/or infraspinatus tear, minimal to no arthritis, and a fully functioning deltoid muscle (Table 1). The procedure can be performed either in an open manner or arthroscopically (beach-chair or lateral decubitus position). In this description, the patient is positioned in the beach-chair position. The arm is maintained comfortably at the patient's side ("neutral abduction") and in neutral rotation. The glenohumeral joint is thoroughly evaluated with a 30° arthroscope (Arthrex, Naples, FL) from both the posterior and lateral viewing portals (Video 1). An attempt is made to repair as much of the rotator cuff as possible (e.g., subscapularis and infraspinatus) to aid in balancing the normal force couples of the shoulder. If the biceps is either torn or unstable, a biceps tenodesis or tenotomy is performed. If at least the supraspinatus still cannot be repaired, the superior glenoid and greater tuberosity bone beds should be debrided and prepared for reconstruction, using a Torpedo shaver and PowerRasp (Arthrex). The superior labrum is left intact because it is an important stabilizer to the glenohumeral joint.^{13,14} We prepare the superior glenoid just medial to the superior labrum because this is the normal attachment of the superior capsule.

A lateral portal is created, and a 10-mm PassPort cannula (Arthrex) is placed into the portal. The length is determined based on the size of the patient and tissue depth and is usually 4 cm. With the arthroscope placed through the lateral portal, a Neviaser portal is created. A 3.0-mm BioComposite SutureTak (Arthrex) is placed

From Private Practice (A.M.H.), Sacramento, California; and Collier Sports Medicine & Orthopaedic Center (C.R.A.), Naples, Florida, U.S.A.
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The **recent** studies on the **biomechanics** of the **superior capsule** suggest that the original ideas suggested by Burkhart et al.¹⁶ regarding the **rotator cable complex** were correct in their assessment of its necessity to keep the glenohumeral joint stable and **reduced**. This complex does keep the humeral head from subluxating superiorly. However, the actual key stabilizer is not the rotator cuff. The rotator cuff is not the main constraint to maintaining the glenohumeral joint reduced; **the capsule is the key static superior stabilizer**. The **rotator cuff** is a **dynamic stabilizer**; it helps to reinforce the capsule and **gives strength to movements overhead**. This concept explains **why** the **SCR** can alleviate the **severe pain** and disability from irreparable massive rotator cuff tears and illustrates how the rotator cuff does not have to be repaired in these savage situations

Hirahara AM, Adams CR. Arthroscopic superior capsular reconstruction for treatment of massive irreparable rotator cuff tears. *Arthroscopy Tech* 2015;4:e637-e641.

SCR - MIHATA



Original Article With Video Illustration

Clinical Results of Arthroscopic Superior Capsule Reconstruction for Irreparable Rotator Cuff Tears

Teruhisa Mihata, M.D., Ph.D., Thay Q. Lee, Ph.D., Chisato Watanabe, M.D., Ph.D.,
Kunimoto Fukunishi, M.D., Mutsumi Ohue, M.D., Tomoyuki Tsujimura, M.D.,
and Mitsuo Kinoshita, M.D., Ph.D.

Purpose: The objective of this study was to investigate the clinical outcome and radiographic findings after arthroscopic superior capsule reconstruction (ASCR) for symptomatic irreparable rotator cuff tears. **Methods:** From 2007 to 2009, 24 shoulders in 23 consecutive patients (mean, 65.1 years) with irreparable rotator cuff tears (11 large, 13 massive) underwent ASCR using fascia lata. We used suture anchors to attach the graft medially to the glenoid superior tubercle and laterally to the greater tuberosity. We added side-to-side sutures between the graft and infraspinatus tendon and between the graft and residual anterior supraspinatus/subscapularis tendon to improve force coupling. Physical examination, radiography, and magnetic resonance imaging (MRI) were performed before surgery; at 3, 6, and 12 months after surgery; and yearly thereafter. Average follow-up was 34.1 months (24 to 51 months) after surgery. **Results:** Mean active elevation increased significantly from 84° to 148° ($P < .001$) and external rotation increased from 26° to 40° ($P < .01$). Acromiohumeral distance (AHD) increased from 4.6 ± 2.2 mm preoperatively to 8.7 ± 2.6 mm postoperatively ($P < .0001$). There were no cases of progression of osteoarthritis or rotator cuff muscle atrophy. Twenty patients (83.3%) had no graft tear or tendon retear during follow-up (24 to 51 months). The American Shoulder and Elbow Surgeons (ASES) score improved from 23.5 to 92.9 points ($P < .0001$). **Conclusions:** ASCR restored superior glenohumeral stability and function of the shoulder joint with irreparable rotator cuff tears. Our results suggest that this reconstruction technique is a reliable and useful alternative treatment for irreparable rotator cuff tears. **Level of Evidence:** Level IV, therapeutic case series.

Chronic large to massive rotator cuff tears are challenging to repair completely because of the development of tendon retraction with inelasticity,^{1,2} muscle atrophy,^{1,3-6} and fatty infiltration.¹⁻⁶ Various surgical treatments have been developed, including debridement and subacromial decompression,^{7,8} partial repair,^{9,11} transposition of the subscapularis tendon,^{12,13} transplantation of the teres major muscle,¹⁴ supraspinatus

muscle advancement,¹⁵ deltoid flap reconstruction,¹⁶ latissimus dorsi transfer,¹⁷⁻¹⁹ pectoralis major transfer,²⁰ grafting to the torn tendon,²¹⁻²³ and reverse total shoulder arthroplasty.²⁶⁻²⁸ However, none of these approaches is considered optimal for irreparable rotator cuff tears because any alternative to complete repair has proved inferior in terms of clinical outcome and postoperative complications.¹

The most common signs of irreparable rotator cuff tears are pain from subacromial impingement,^{11,19} muscle weakness in the shoulder joint,^{11,19} and as a result, limitation of arm elevation.^{11,19} These signs result mainly from a loss of the superior stability of the glenohumeral joint because of dysfunction of the rotator cuff muscles. Patients with irreparable rotator cuff tears have a defect of the superior capsule, which is located on the inferior surface of the supraspinatus and infraspinatus tendons. Therefore, we developed a new surgical treatment, arthroscopic superior capsule reconstruction (ASCR) (Figs 1 and 2, and Video 1 [available at www.arthroscopyjournal.org]) to restore superior stability of the shoulder joint because the shoulder capsule plays a role in stabilizing the glenohumeral joint.

From the Departments of Orthopedic Surgery, Osaka Medical College (T.M., C.W., K.F., M.K.), Takatsuki, Osaka; Katsuragi Hospital (M.O.), Osaka; and Veritas Hospital (T.T.), Hyogo, Japan; and the Orthopaedic Biomechanics Laboratory, VA Healthcare System, Long Beach; and the University of California (T.M., T.Q.L.), Irvine, CA, U.S.A.

The authors report that they have no conflicts of interest in the authorship and publication of this article.

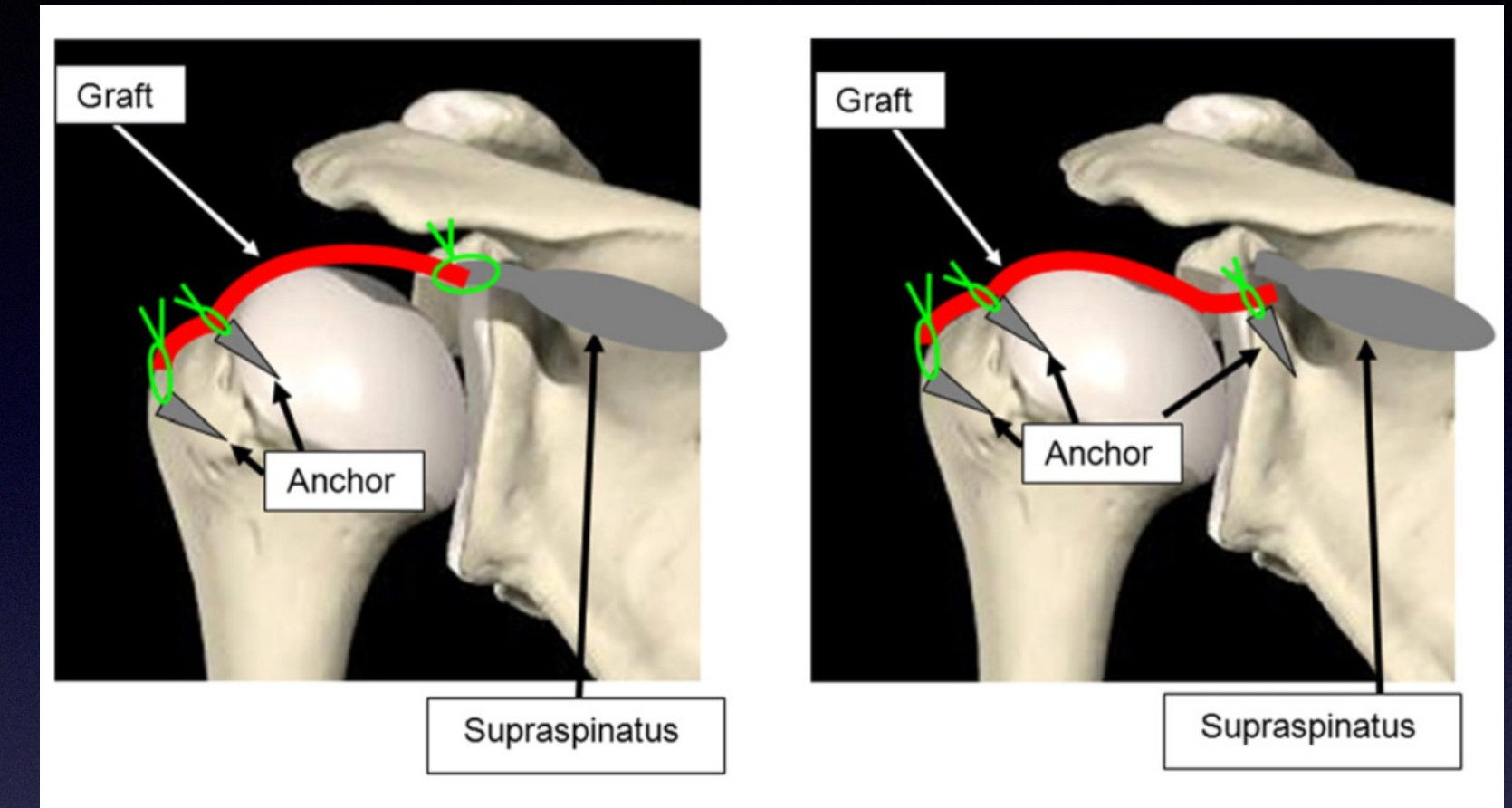
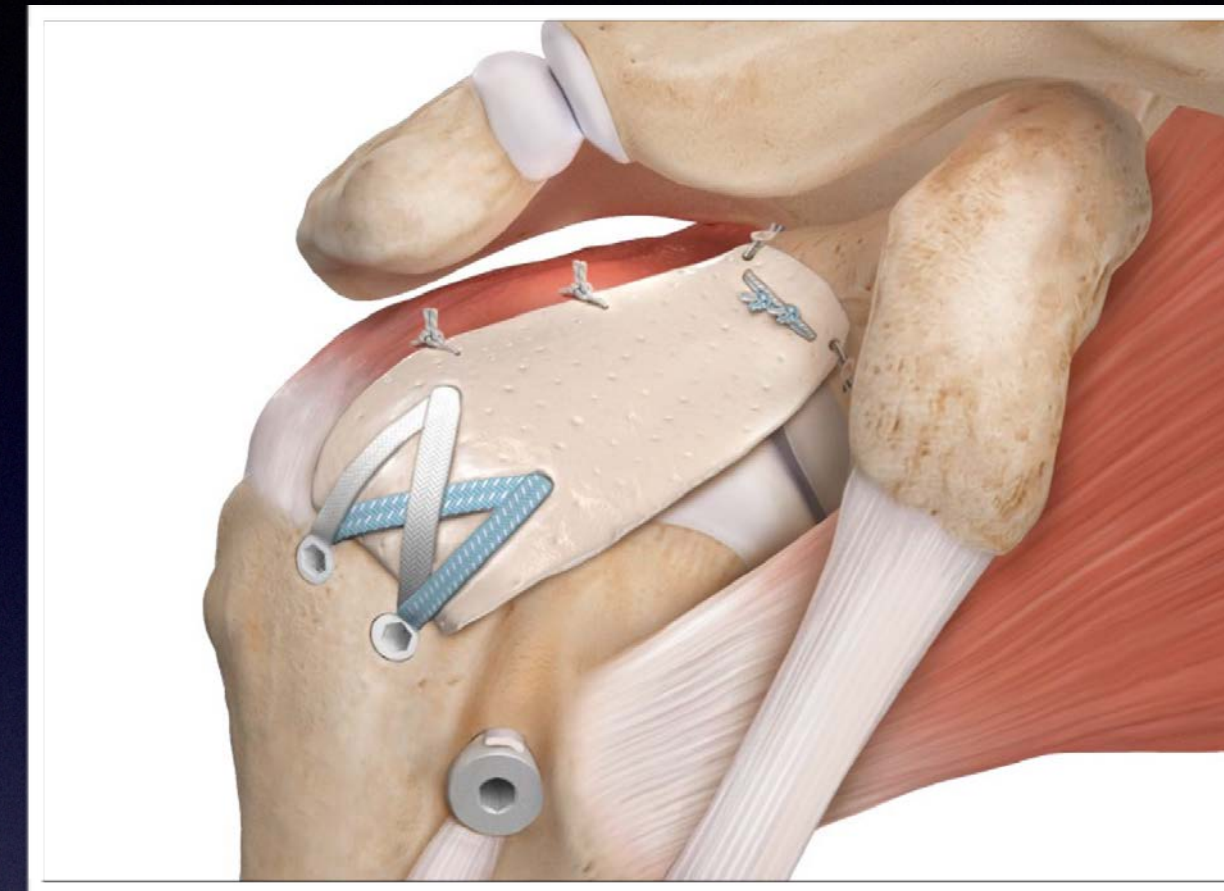
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Autoinjerto: Fascia lata

La técnica de reconstrucción capsular superior fue iniciada por el Dr. Teruhisa Mihata en 2007 para pacientes con desgarros irreparables del manguito rotador. En el estudio de seguimiento de reconstrucción capsular superior realizado en 23 pacientes, se muestra del mes 24 al 51, resultados sobresalientes en el dolor, puntuaciones de ASES y mediciones de distancia acromial-humeral.¹ Dicha técnica refuerza la cápsula superior para mantener la cabeza humeral en la cavidad glenoidea uniendo el tejido de la cavidad glenoidea de la tuberosidad mayor.

Referencia

1. Mihata T, Lee TQ, Watanabe C, et al. Clinical results of arthroscopic superior capsule reconstruction for irreparable rotator cuff tears. *Arthroscopy*. 2013;29(3):459-470. doi:10.1016/j.arthro.2012.10.022.

Table 3. Summary of Patients' Shoulder Functional Scores

Shoulder	ASES Score		JOA Score		UCLA Score	
	Preoperative	Postoperative	Preoperative	Postoperative	Preoperative	Postoperative
1	43.3	100	63.5	100	18	35
2	13.3	100	28.5	100	5	35
3	10	100	26.5	97	4	35
4	16.7	100	44	97	10	34
5	16.7	95	43	92	7	34
6	21.7	100	49.5	97	12	34
7	8.3	100	30	95	6	35
8	26.7	100	35.5	100	5	35
9	13.3	95	43.5	93	9	33
10	28.3	100	49.5	95	13	35
11	20	100	58	99.5	13	35
12	43.3	100	68.5	100	18	35
13	20	88.3	37.5	92.5	7	31
14	18.3	96.7	44	94	8	34
15	51.7	96.7	70.5	92	17	34
16	21.7	95	49.5	95	7	35
17	33.3	78.3	65.5	76.5	17	25
18	15	76.7	32	83	5	22
19	10	70	38	79.5	5	28
20	63.3	100	56.5	100	15	35
21	18.3	100	64	100	12	35
22	28.3	100	57	100	11	35
23	20	65	54.5	72.5	9	21
24	3.3	71.7	49.5	71.5	4	28
Average	23.5	92.9	48.3	92.6	9.9	32.4
SD	14.4	11.3	13.0	9.0	4.7	4.3

ASES, American Shoulder and Elbow Surgeons; JOA, Japanese Orthopaedic Association; UCLA, University of California, Los Angeles. Postoperative = at the final follow-up.

Dermal Allograft

In the original description, autograft **fascia lata** was harvested from the patient's thigh and was secured from the glenoid to the greater tuberosity. This restored the normal superior restraint to proximal migration of the humeral head and in several cases resulted in reversal of **pseudoparalysis**. The original biomechanical and preliminary clinical results are quite promising. The technique described in this article is an arthroscopic reconstruction of the superior capsule with **dermal allograft**.

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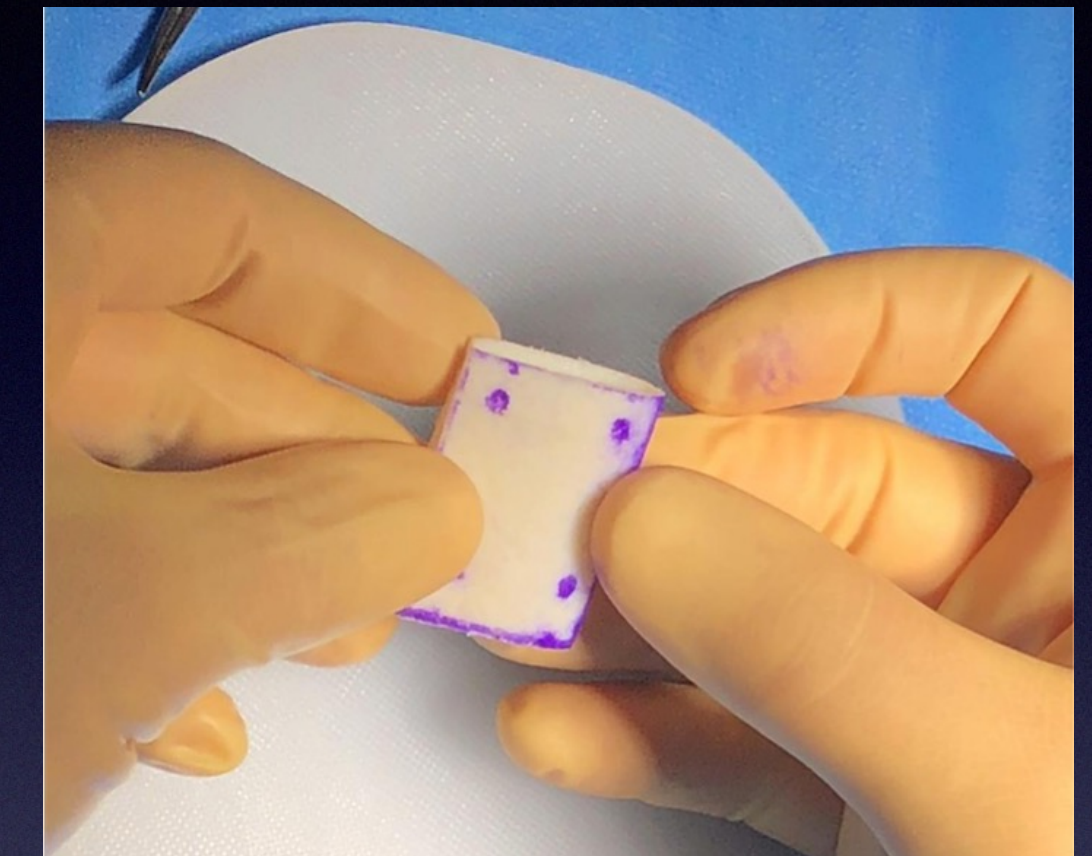
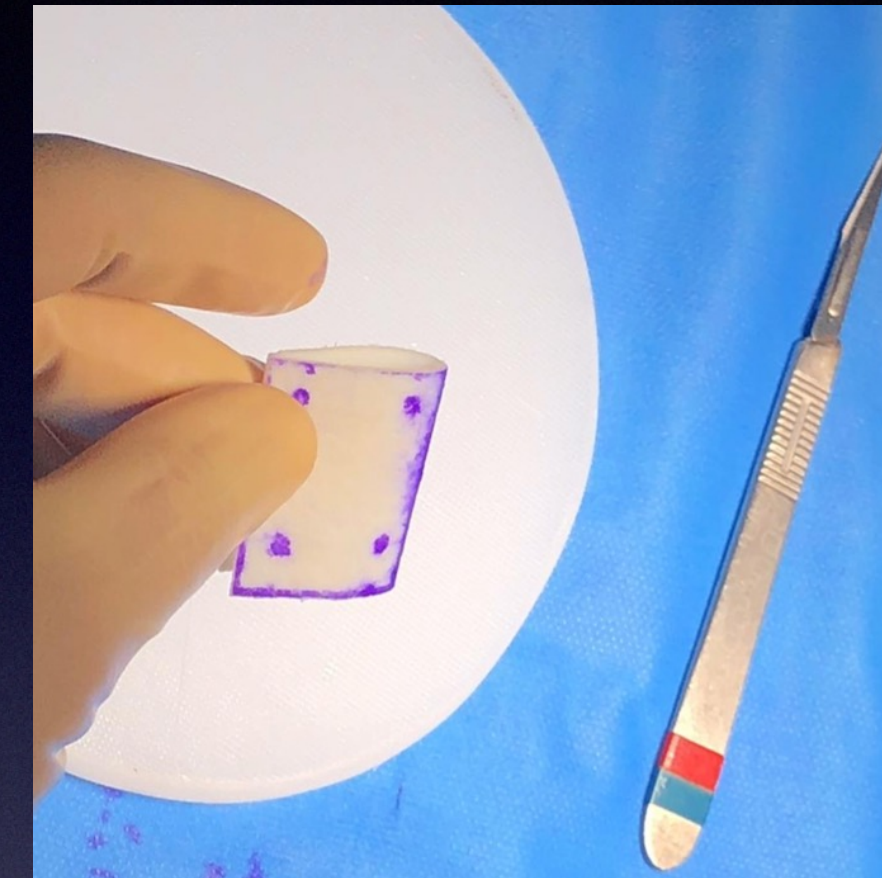
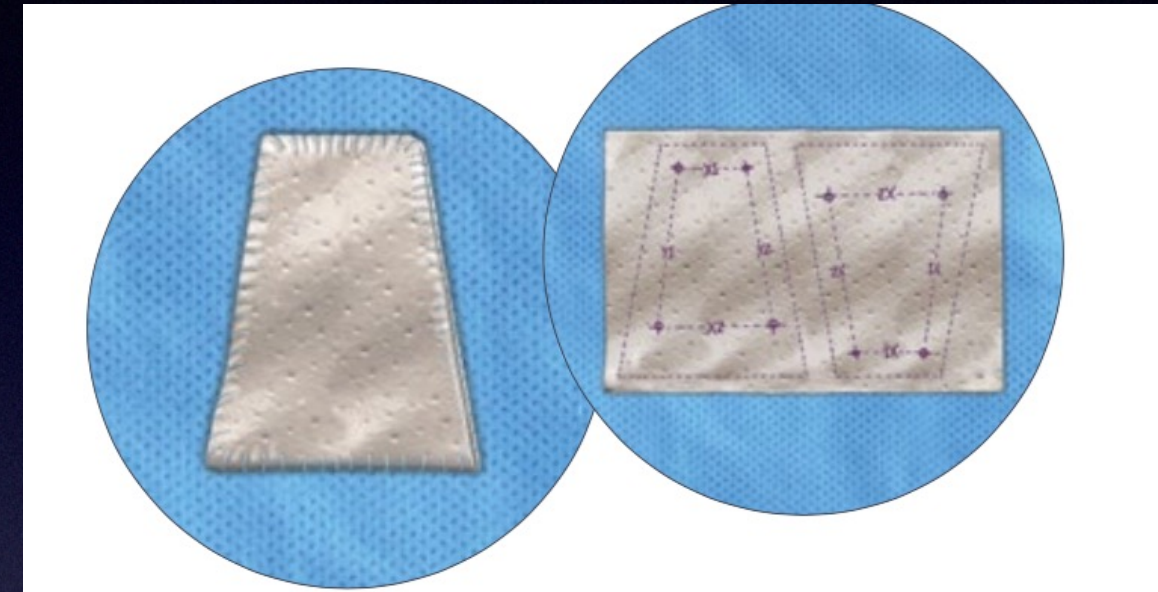
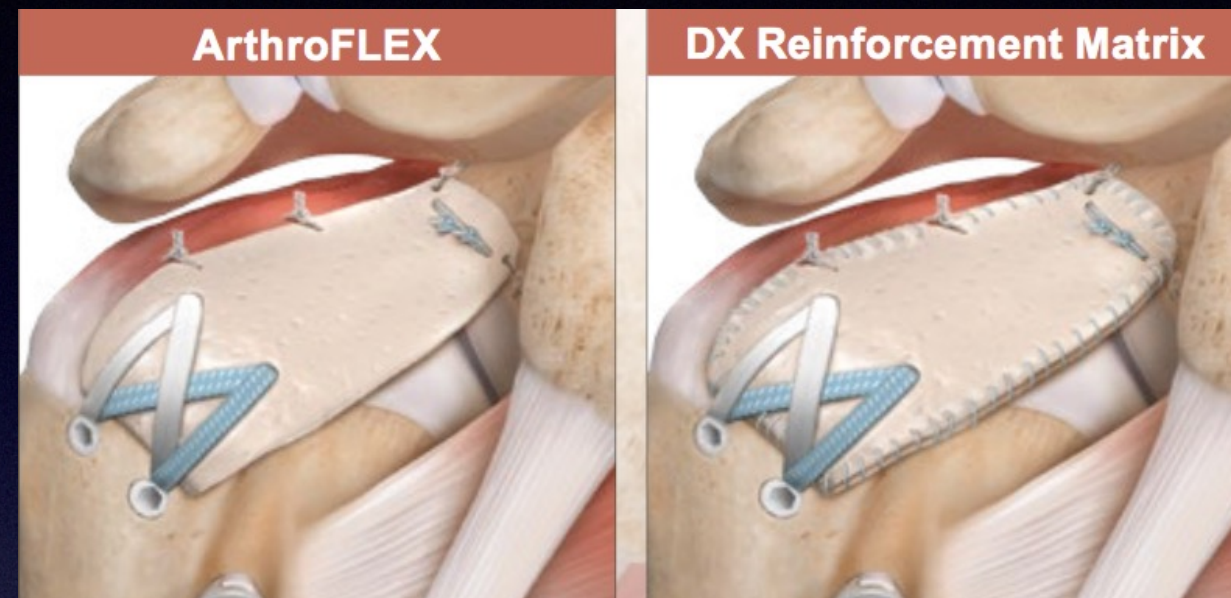
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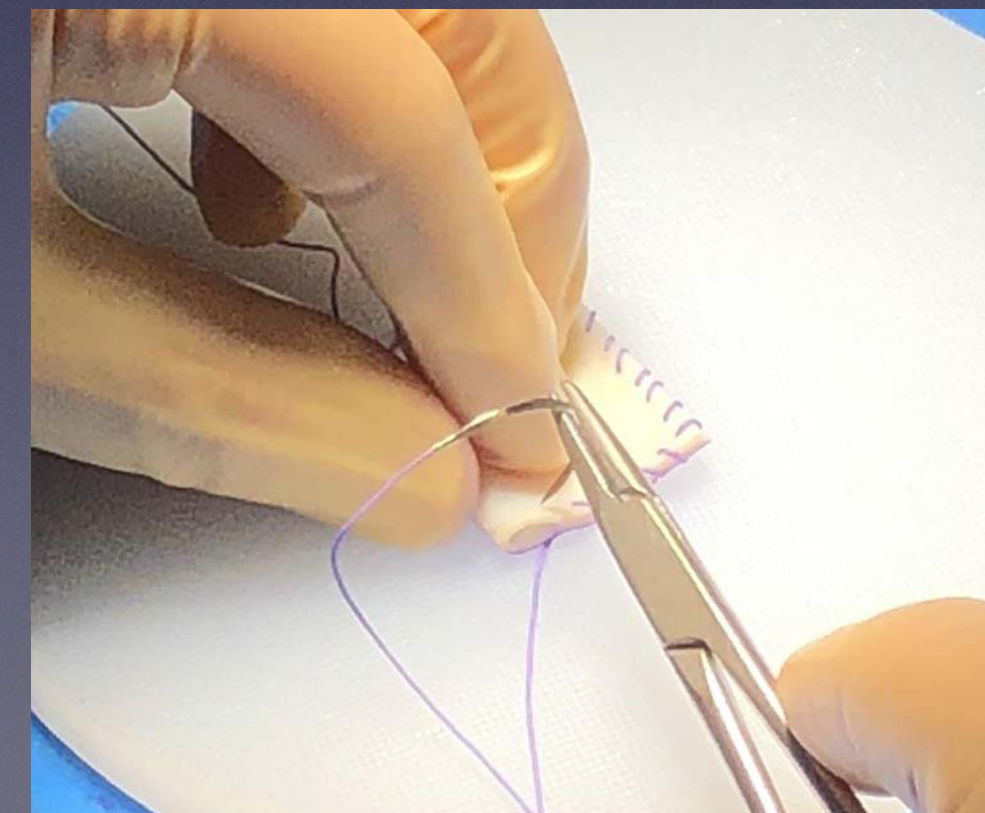
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Dermal Allograft



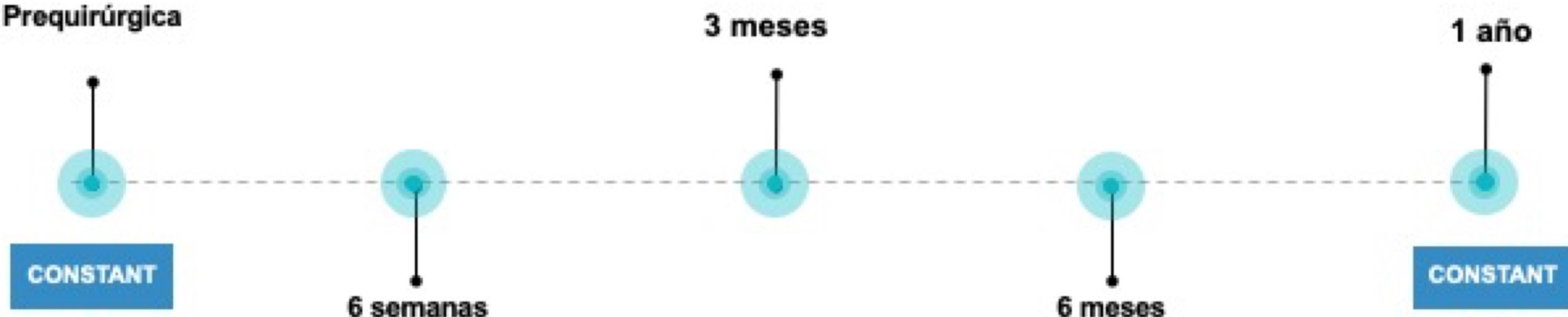
ARTHROFLEX : 3,0 mm grosor
DX Reinforcement Matrix : 1.5 mm
Human Acelular Dermal Matrix EPIFLEX:3 mm



MATERIAL Y MÉTODOS

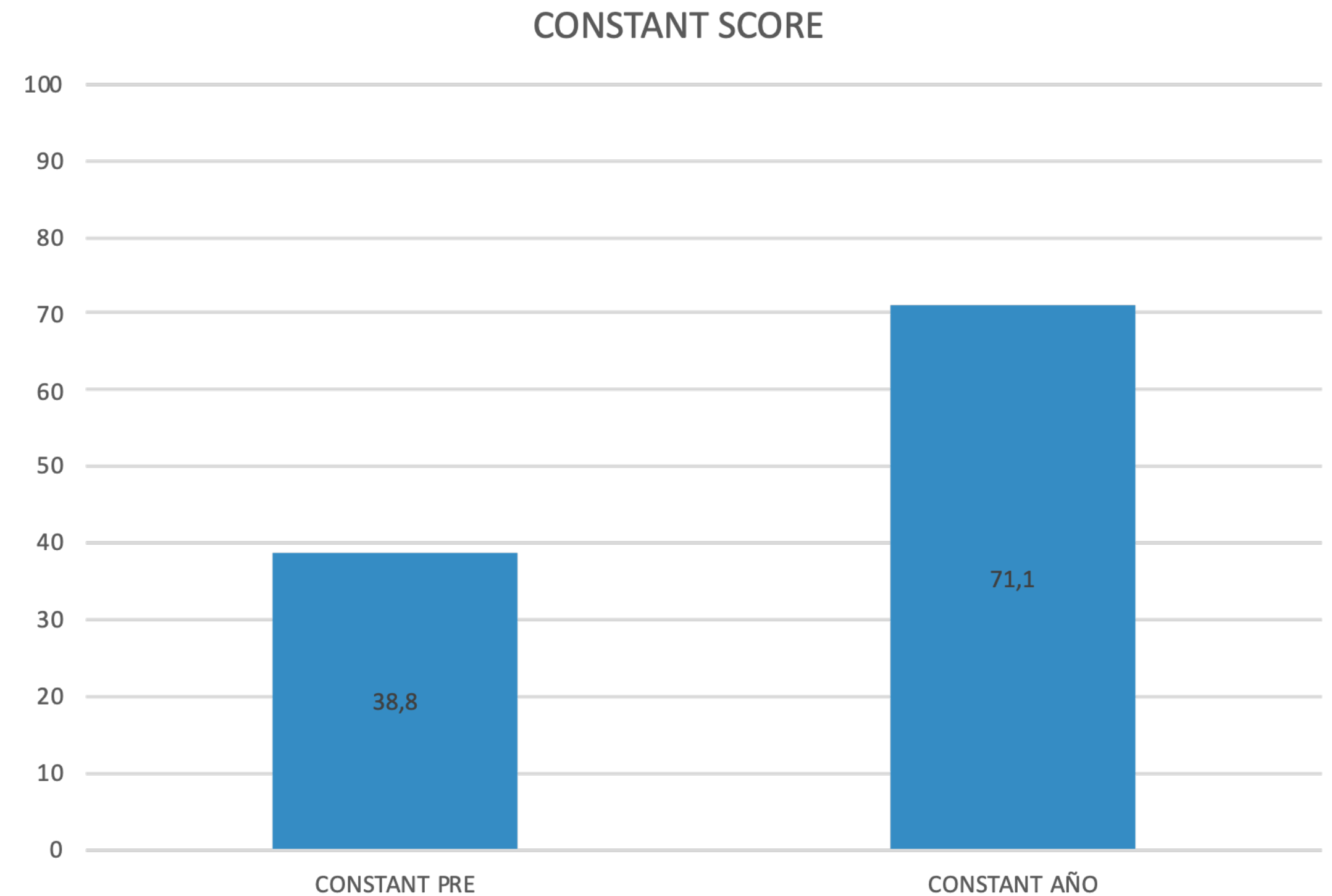
- ▶ Prospectivo
- ▶ Criterios inclusión: rotura masiva manguito
- ▶ 40 pacientes (22 ♀ ,18 ♂), edad media 64'84
- ▶ 25% ya intervenidos con técnica de reparación de manguito
- ▶ Seguimiento:

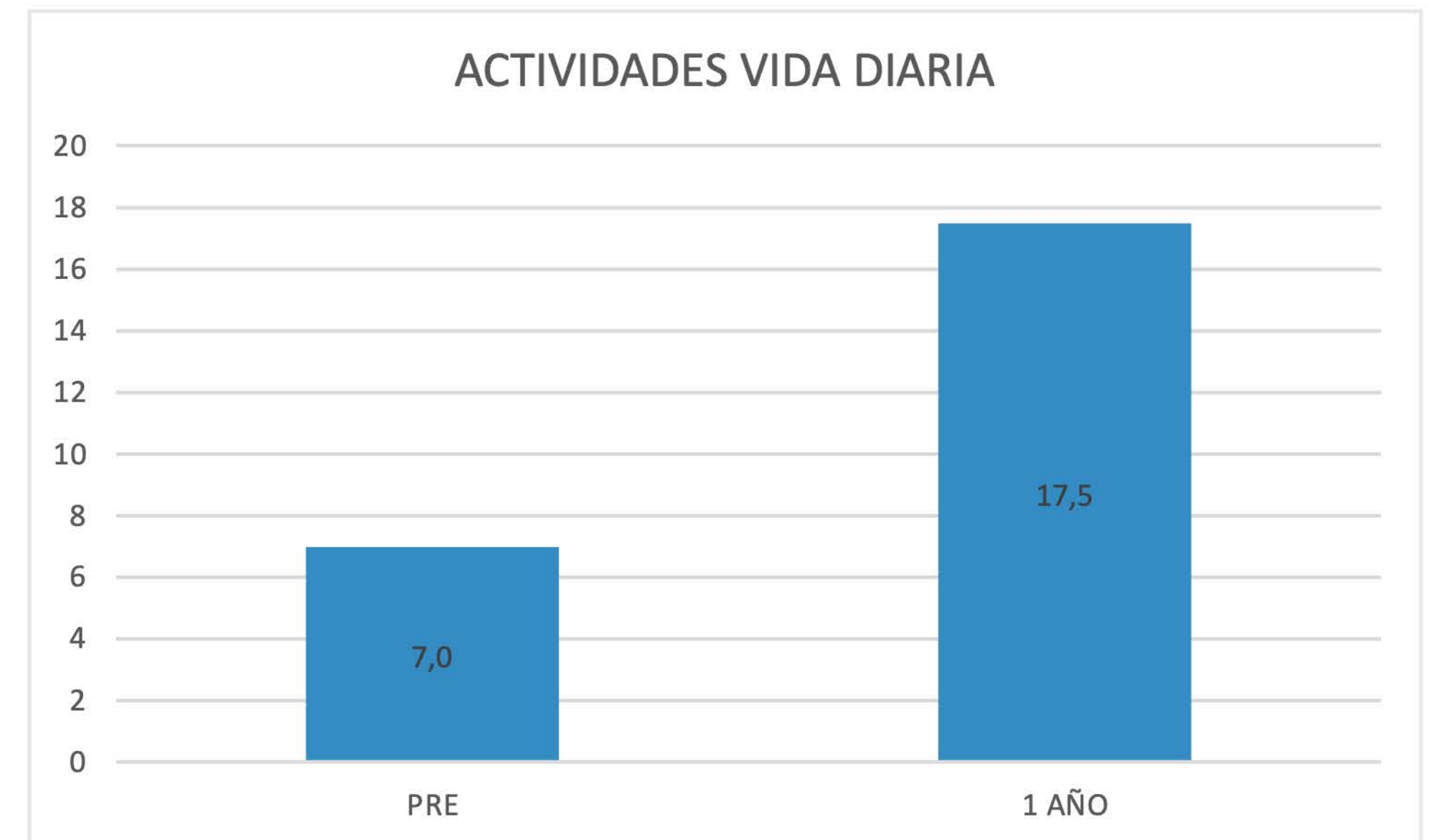
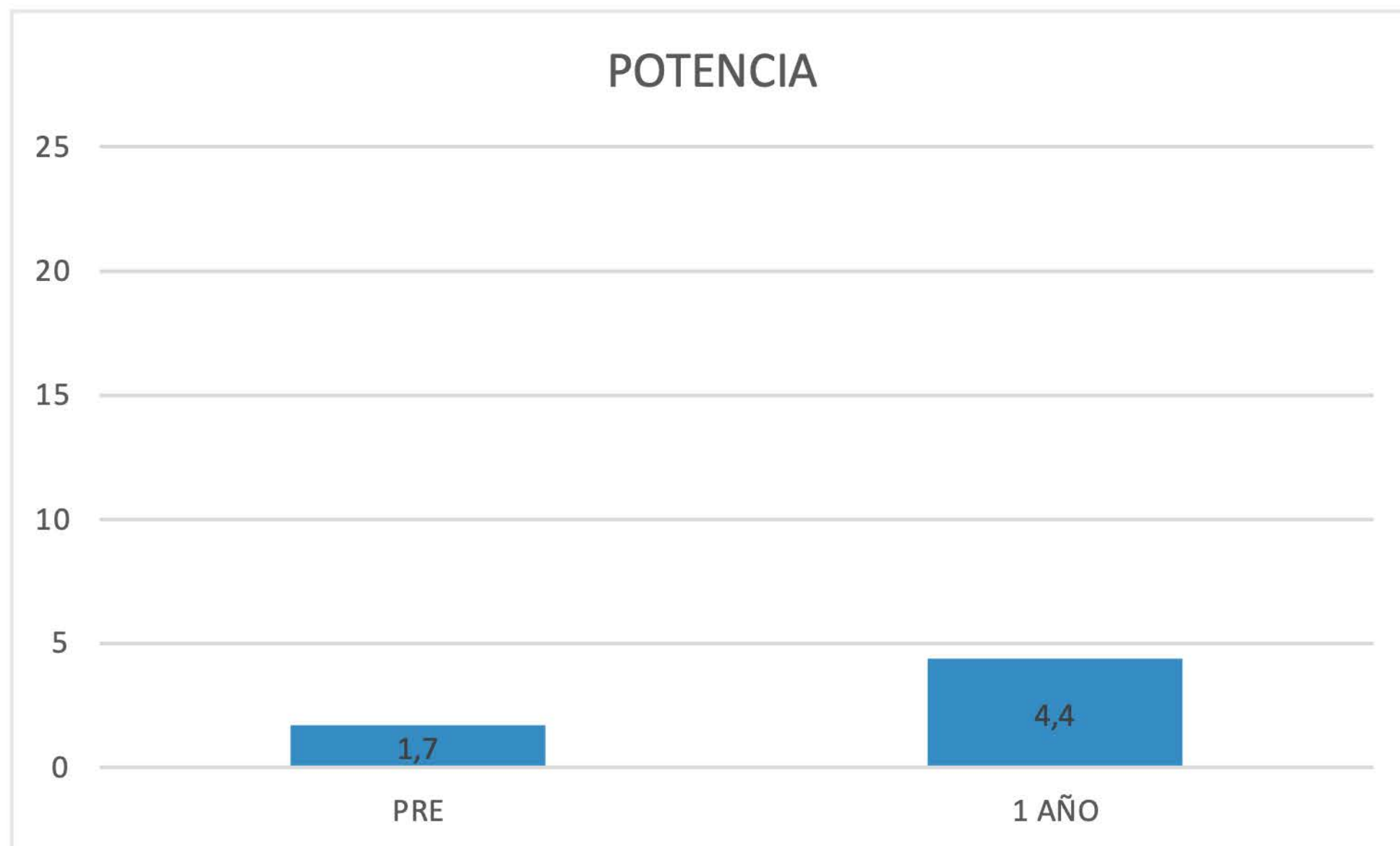
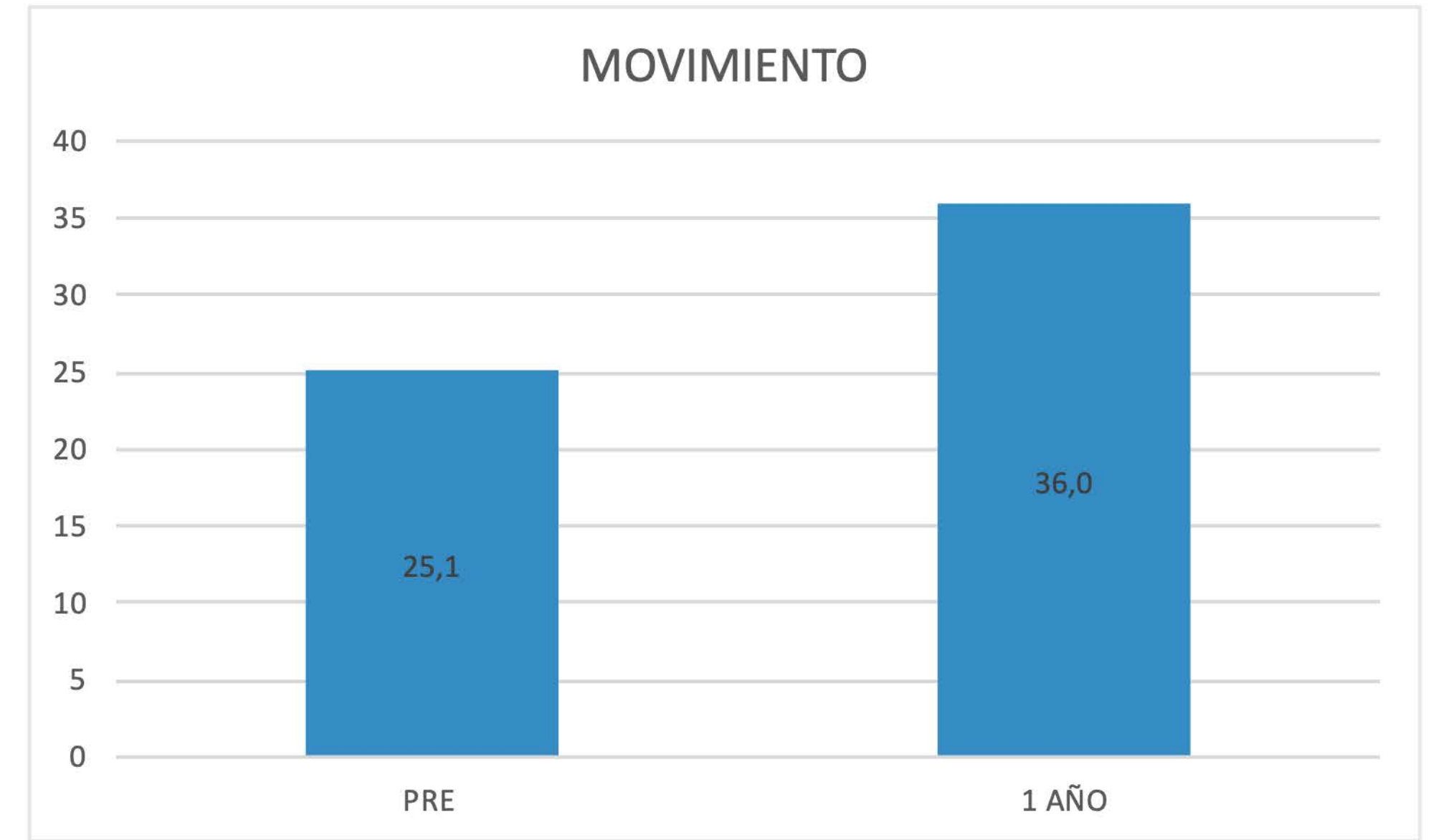
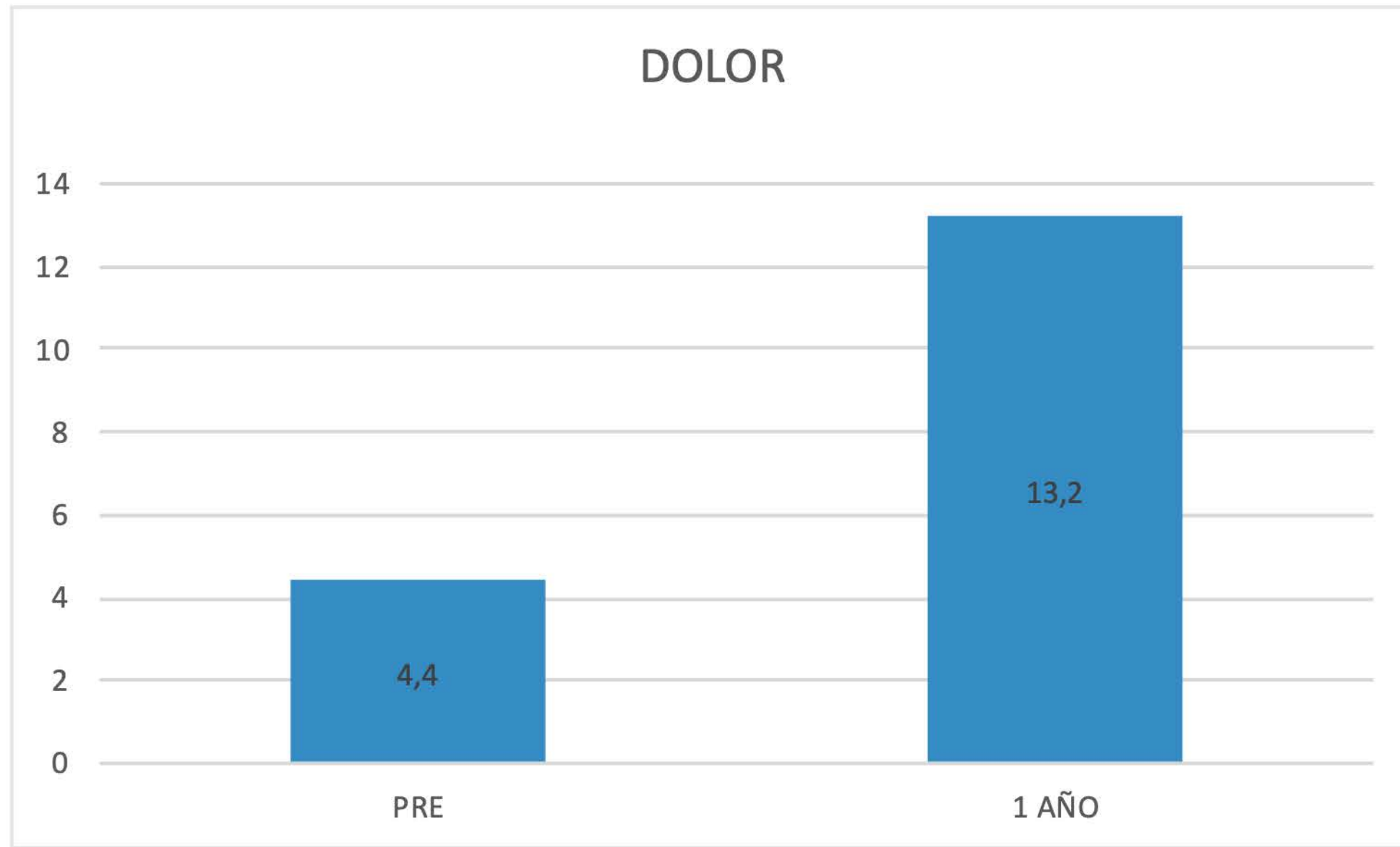
Prequirúrgica



RESULTADOS

- ▶ **Complicaciones**
 - ▶ **Intraoperatoria:**
 - ◆ Desinserción anclaje glenoideo
 - ▶ **Postoperatorio:**
 - ◆ Infección herida qx
 - ◆ Seroma herida qx
 - ◆ Luxación traumática



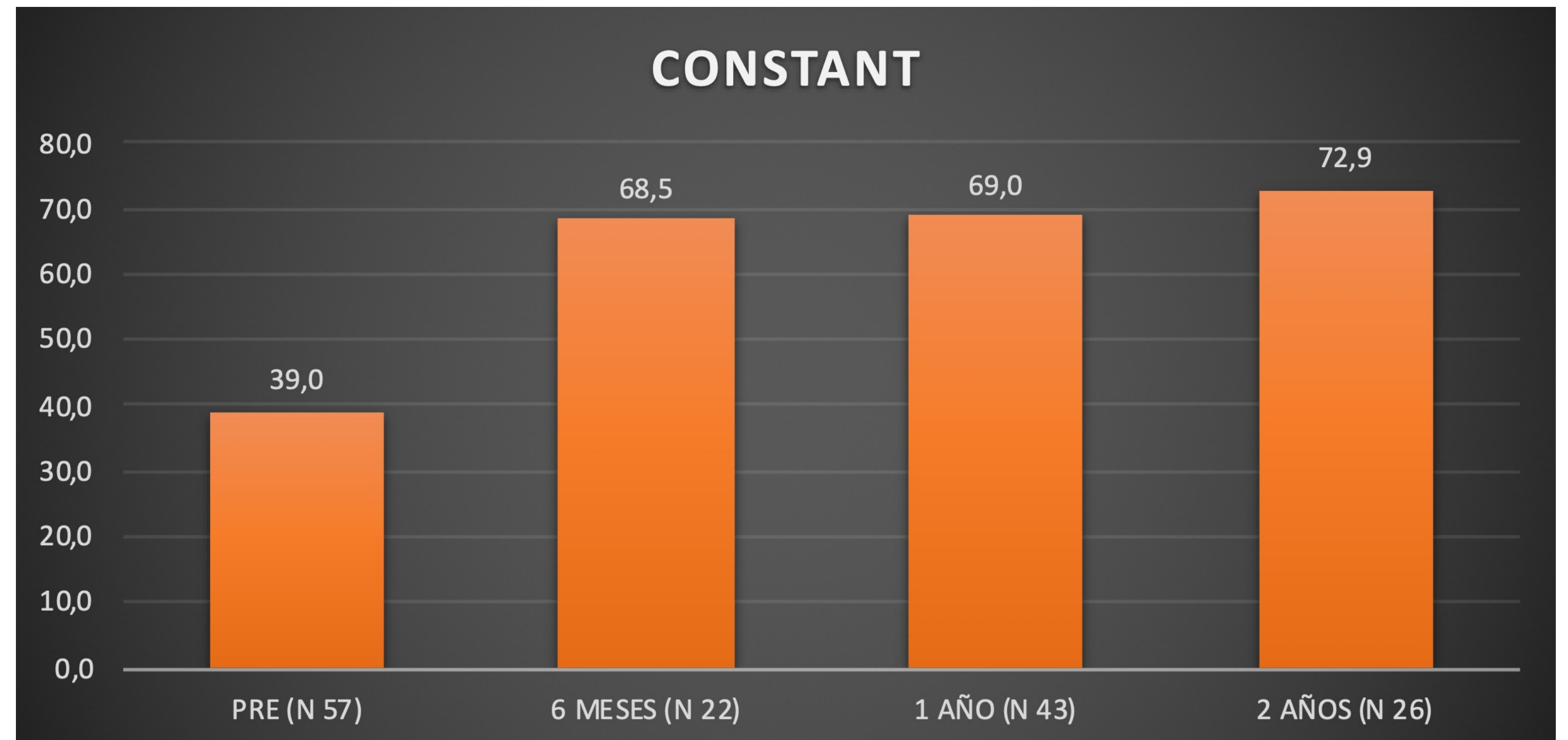


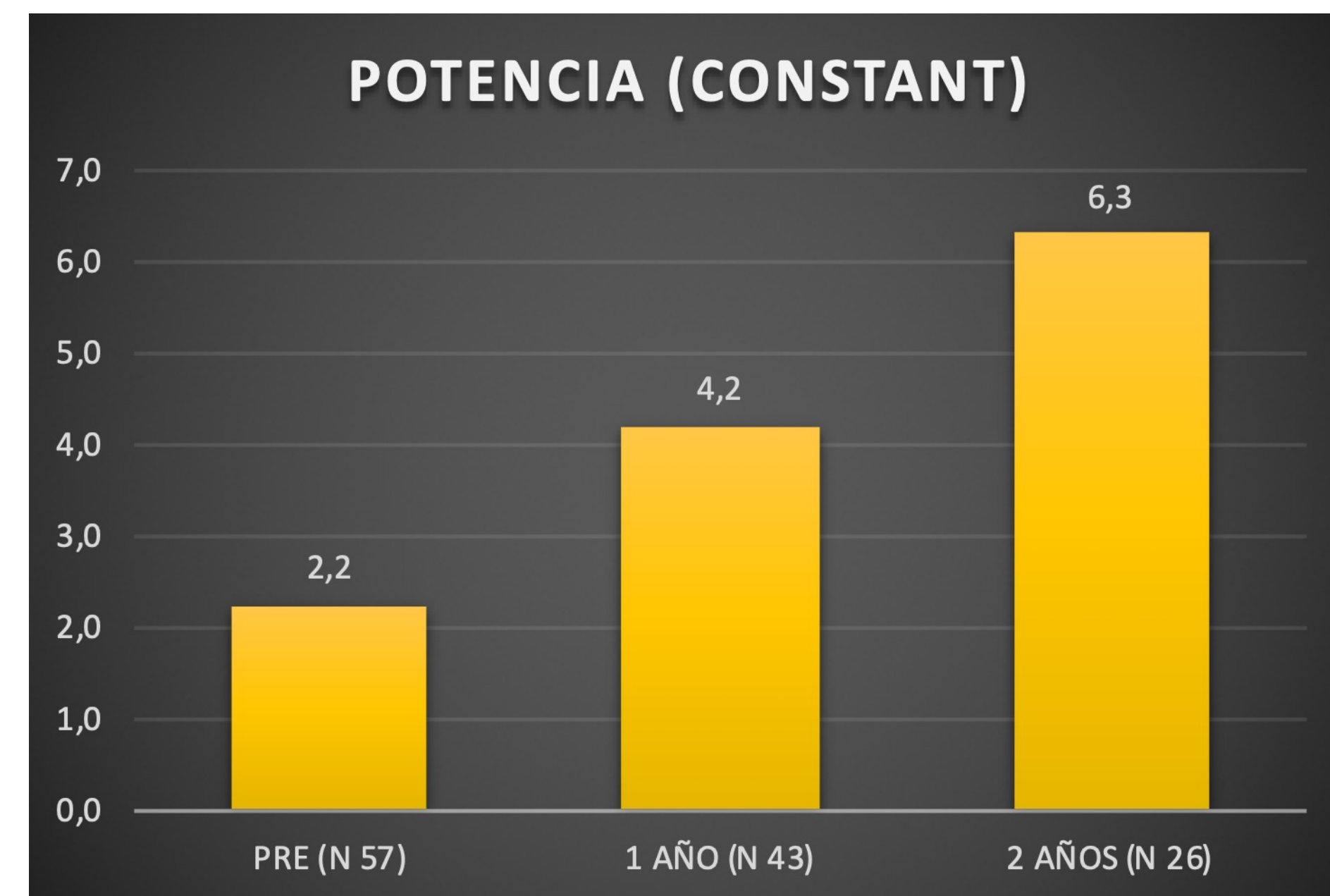
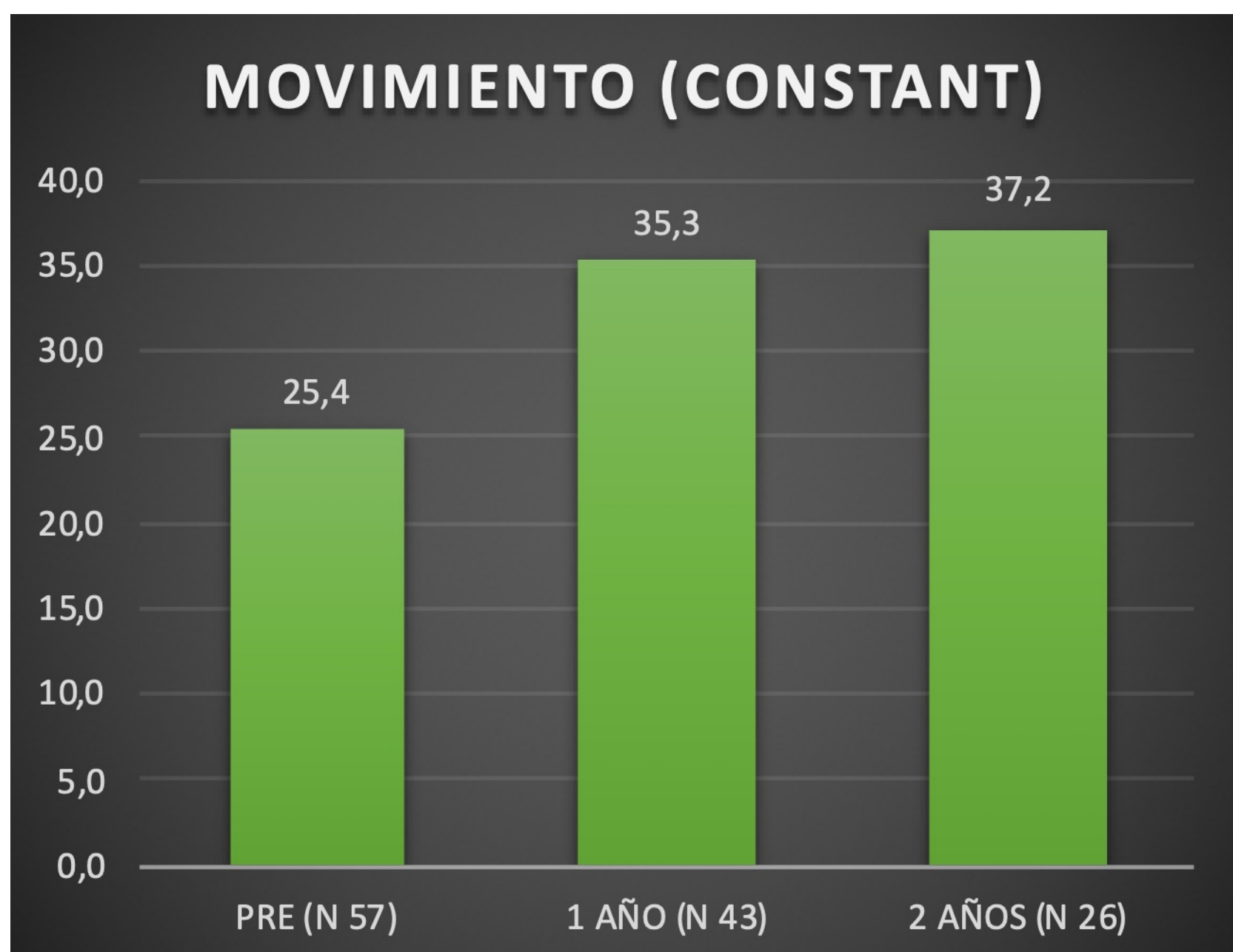
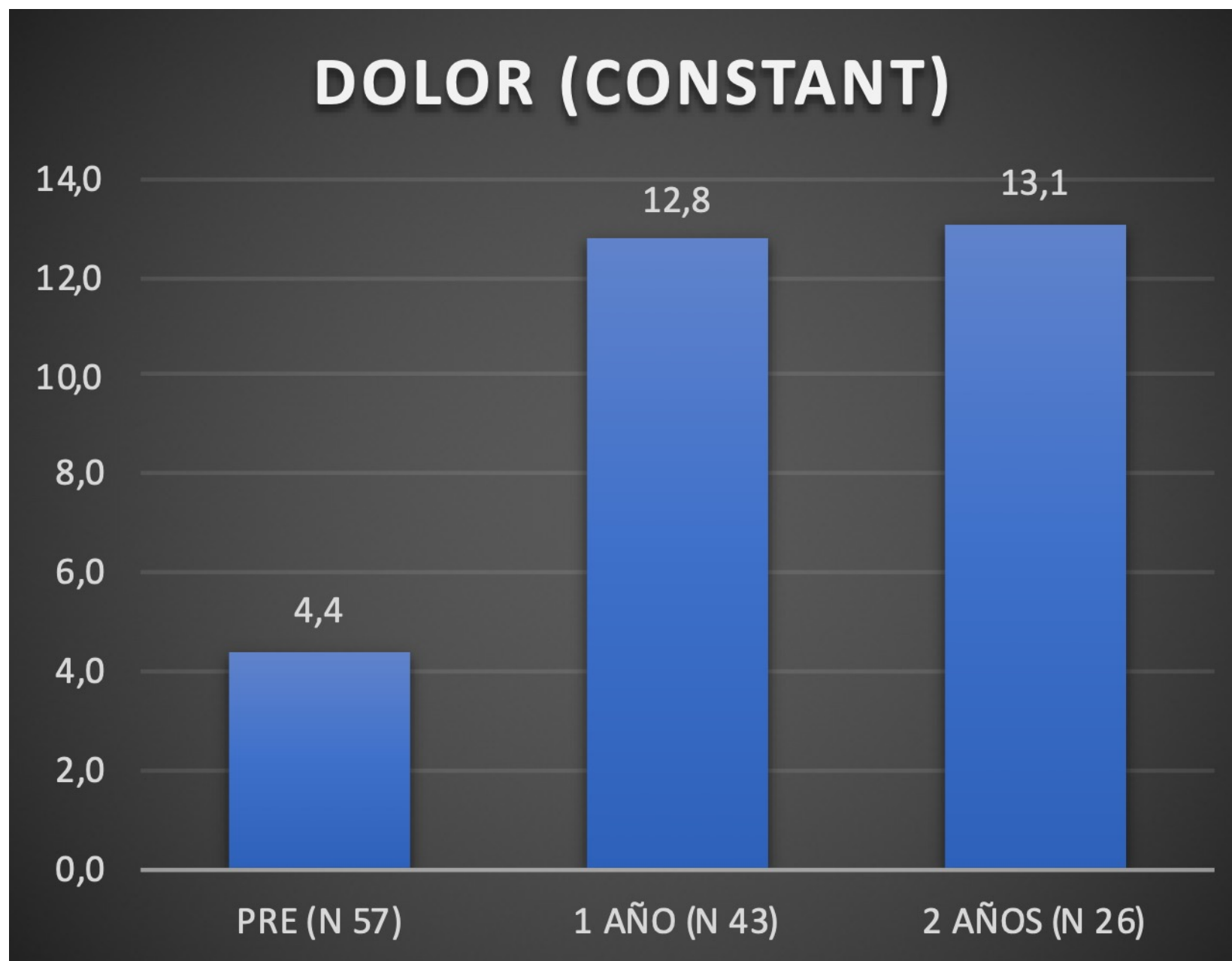
RESULTADOS PROVISIONALES 2 años

Nº PACIENTES

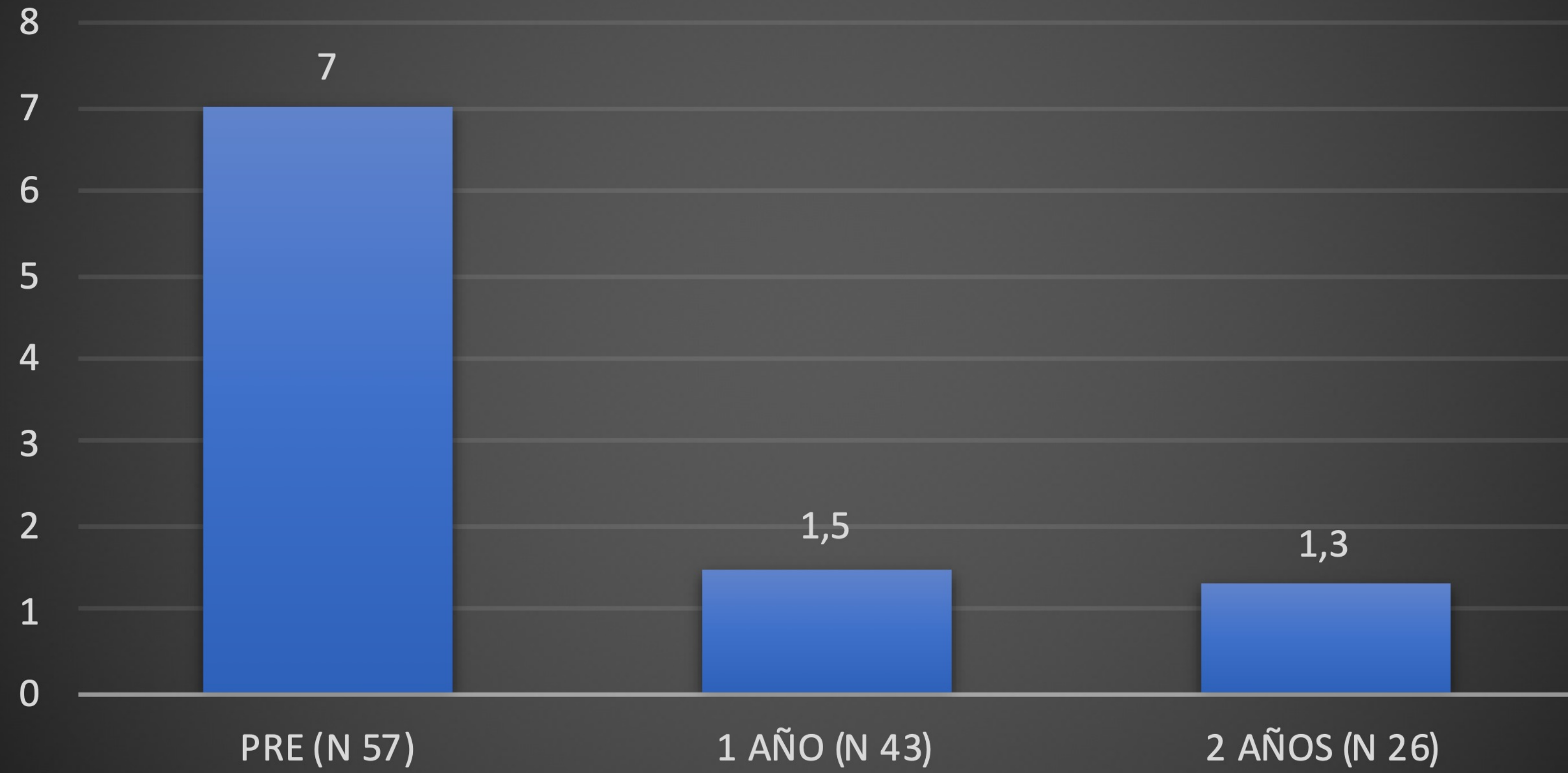
CONSTANT 1 año: **43**

CONSTANT 2 años: **26**





EVA



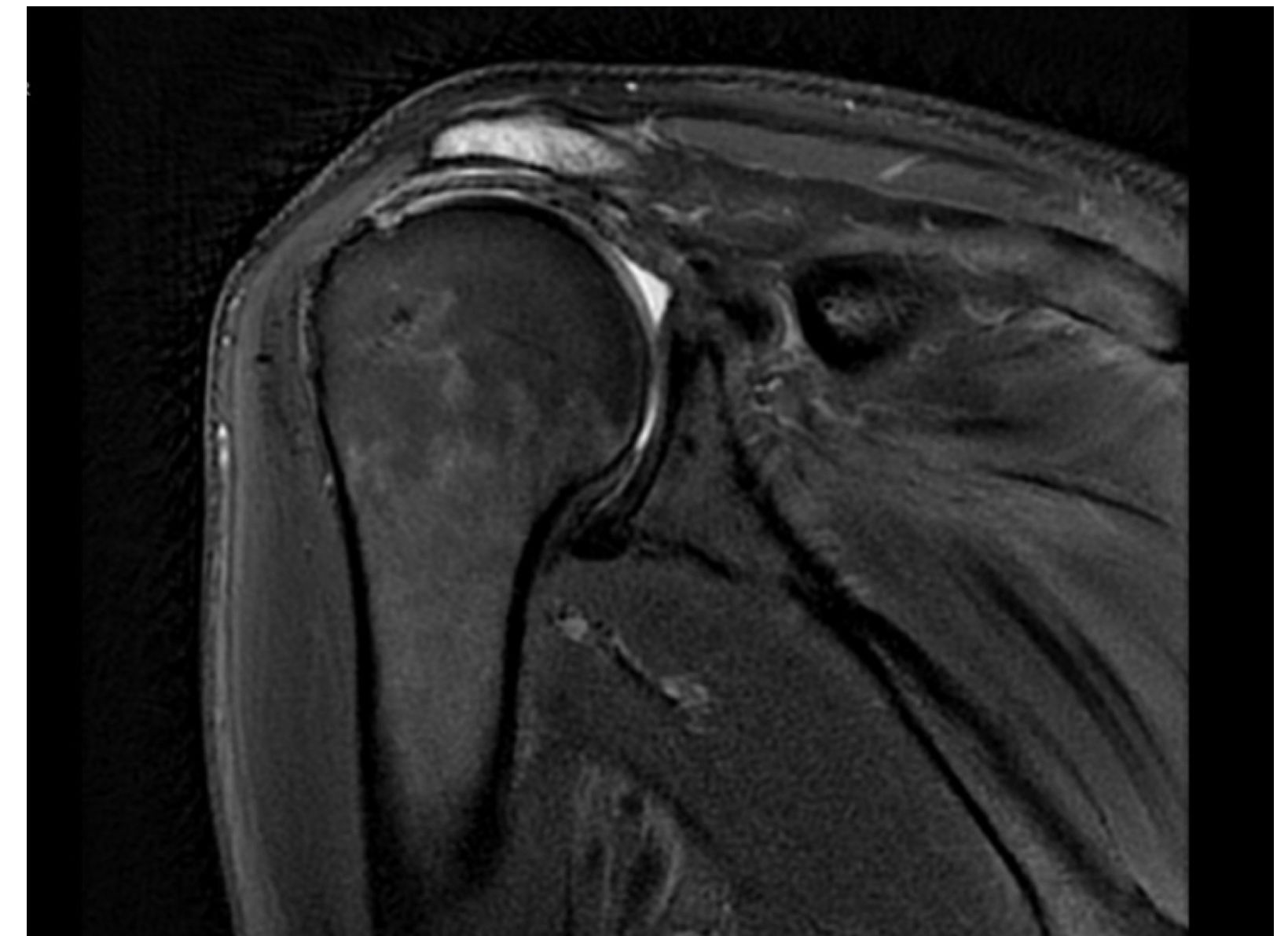
DISTANCIA ACROMIO HUMERAL

-0.085cm



VISUALIZACION DEL INJERTO

30%

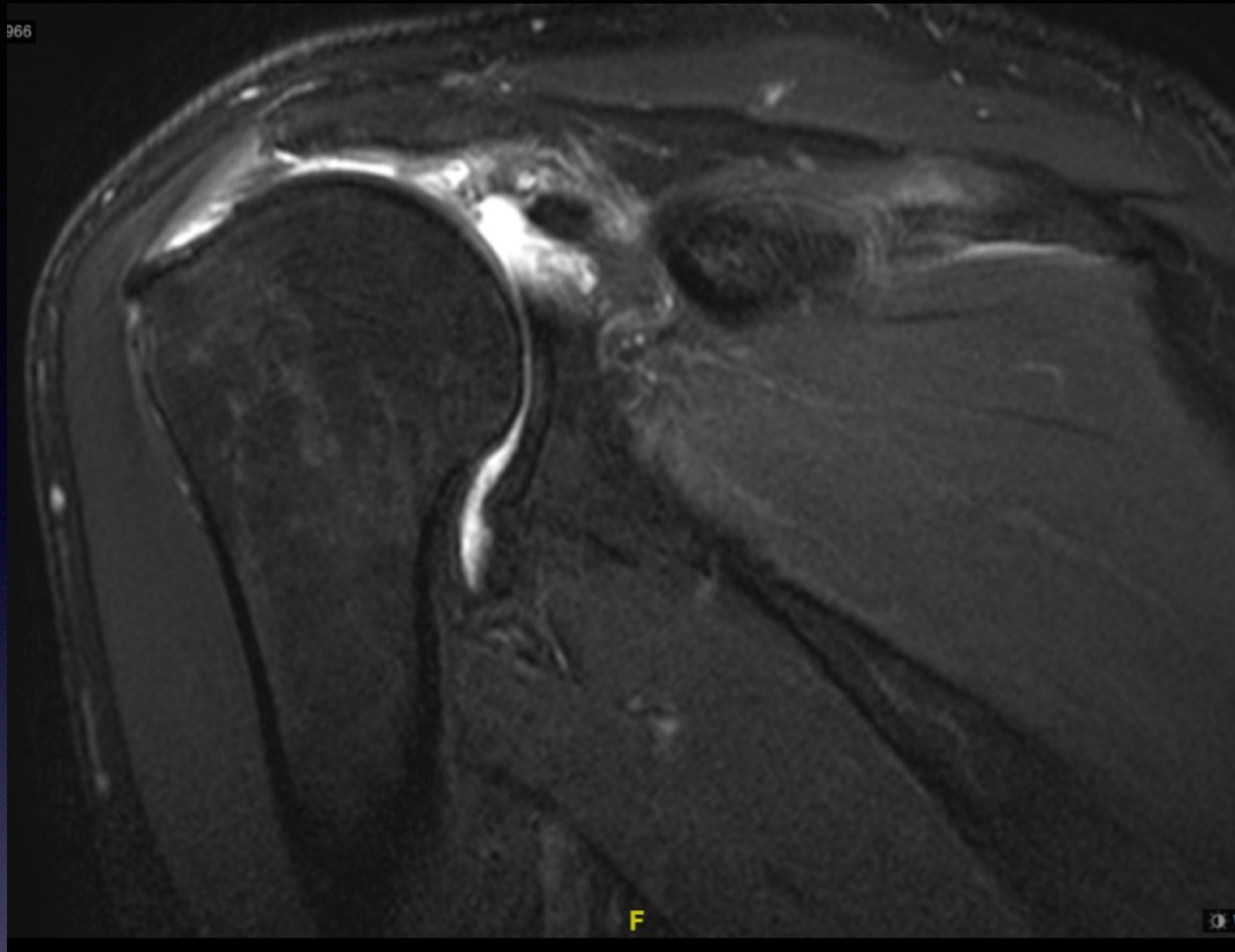


CASO CLINICO 1

SCR

- Varón. 57 años. Trabajador manual.
- Antecedente: Caída bicicleta previa (antigua).
- CLÍNICA: Dolor severo ,impotencia funcional hombro derecho. (ACTIVA). ABD 90°.
- MOVILIDAD PASIVA OK.
- Impingement +. Jobe+. Empty can++
- HAMADA 2
- CONSTANT : 58

966



F

Se: 501
Im: 20/20

H COMPARACION

Study Date: 08-Sep-2017
Study Time: 15:07:03



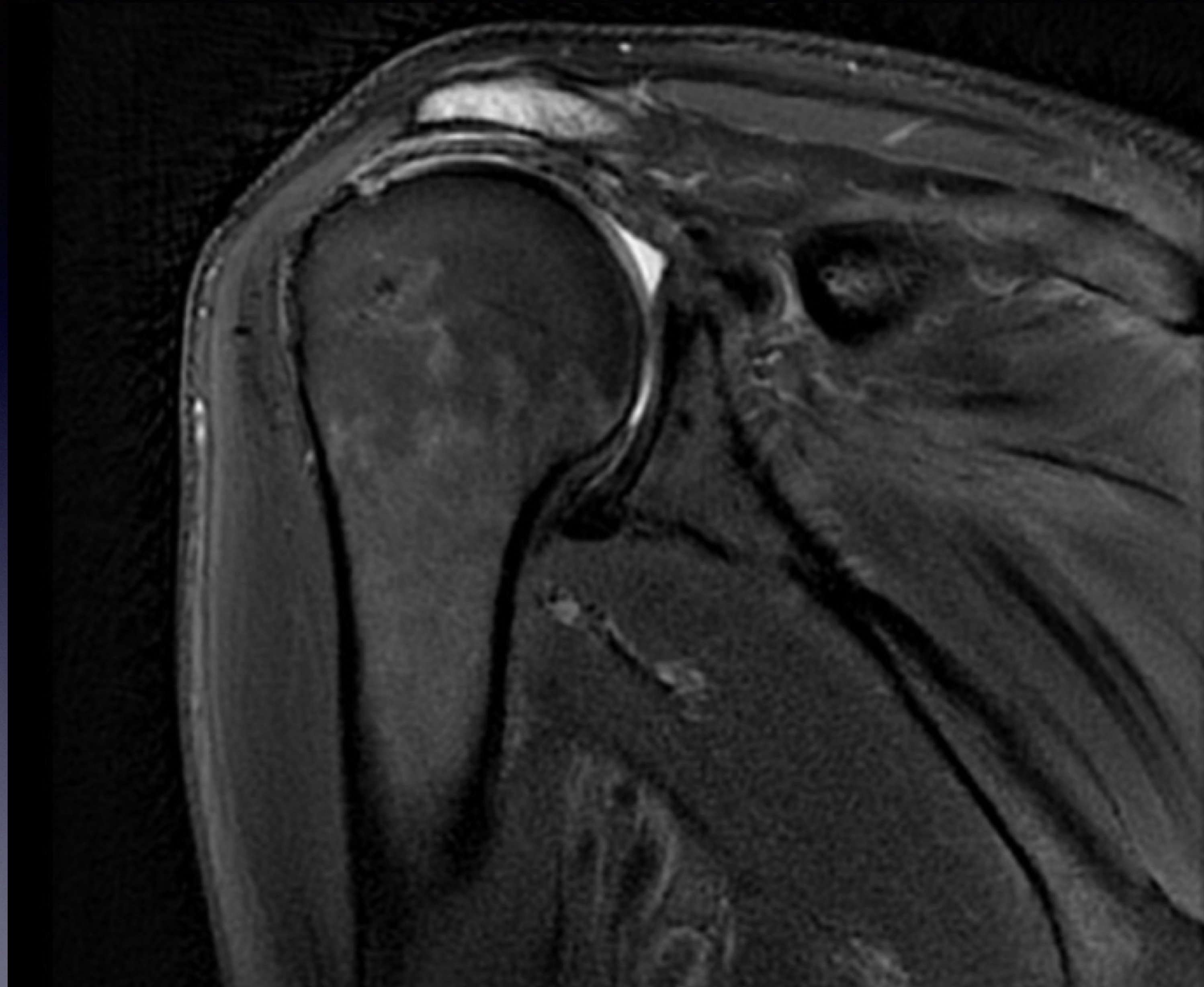
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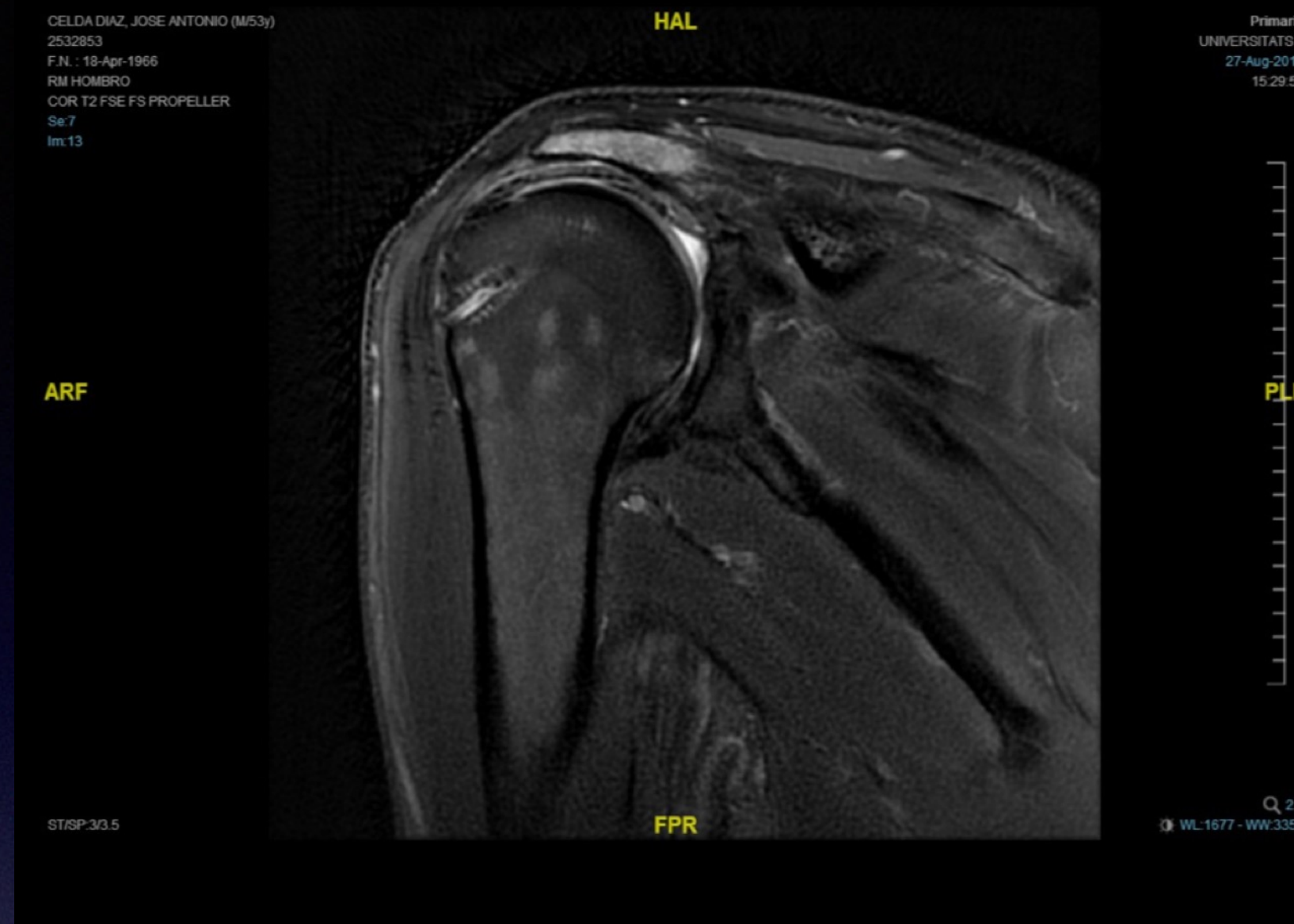
1 LA
cm

F

WL:483 - WW:840

- INTERVENCION QUIRURGICA: 2018 - Injerto “Epiflex”.
- 3 meses evolución. Movilidad completa, sin dolor.
- 1 año evolución. Movilidad completa, sin dolor. No fuerza (4kg). Se solicita RM.
- 2 años. CONSTANT: 88





RM 1 año

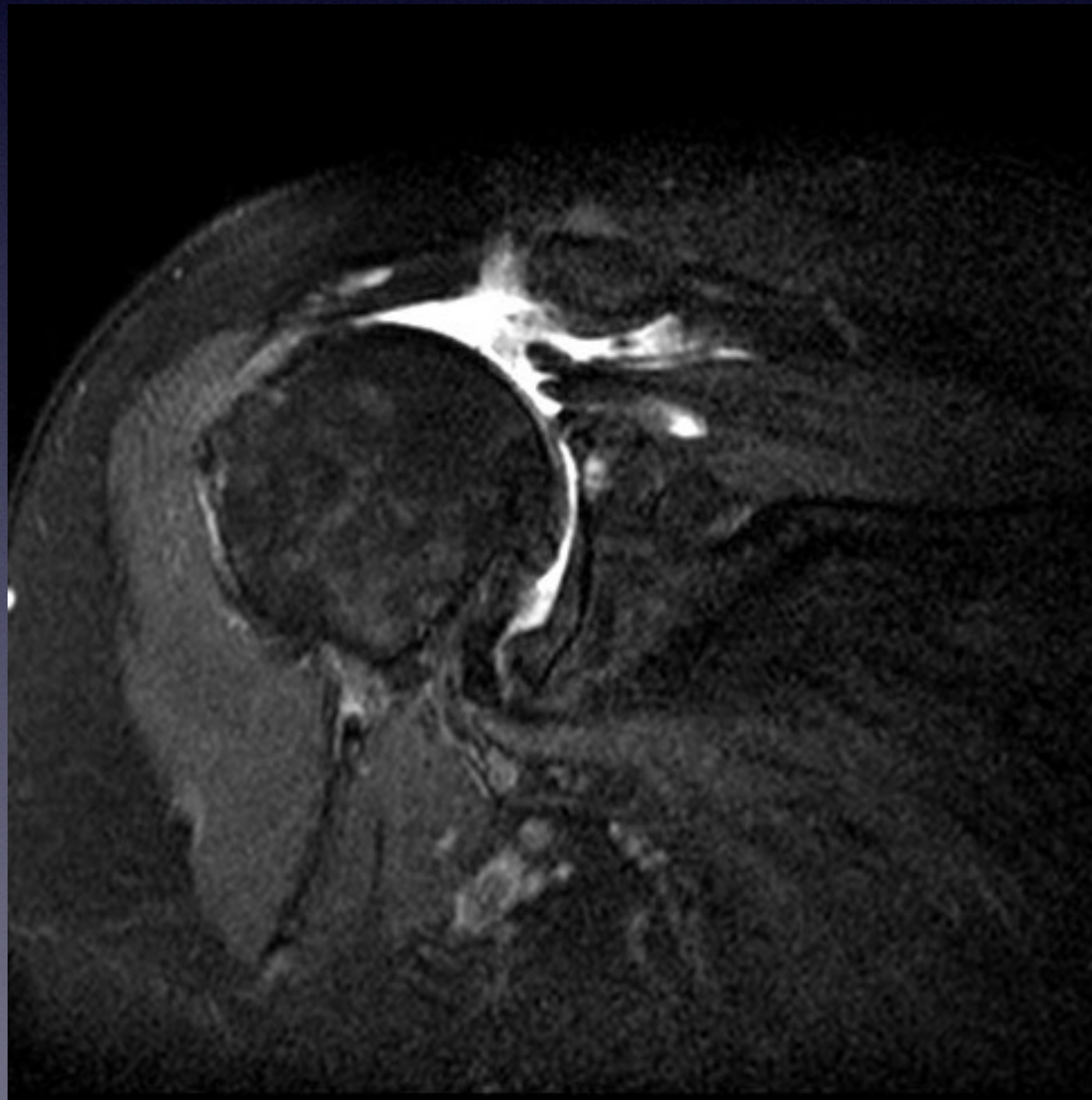
Movilidad a los 3 meses



CASO CLINICO 2

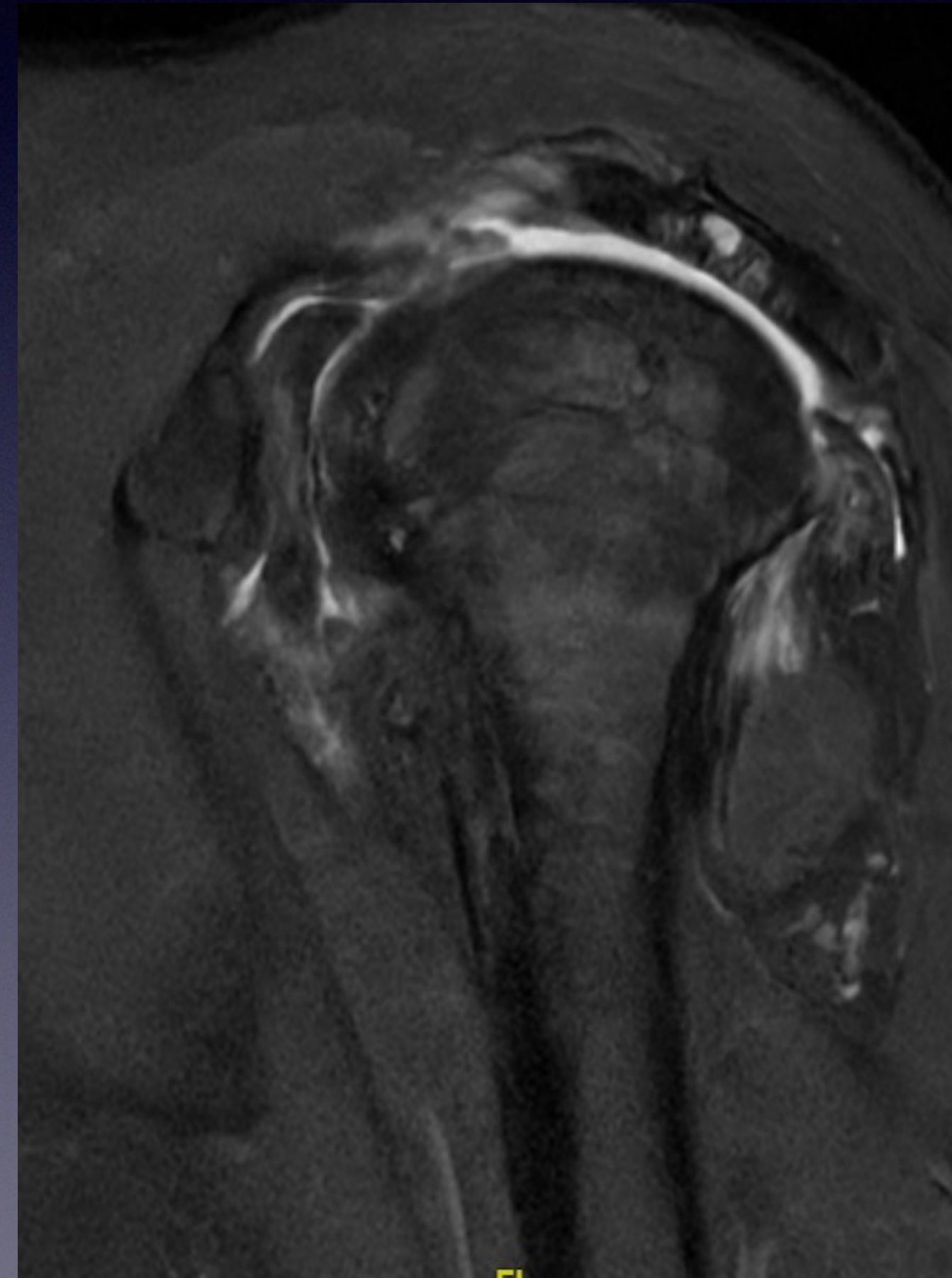
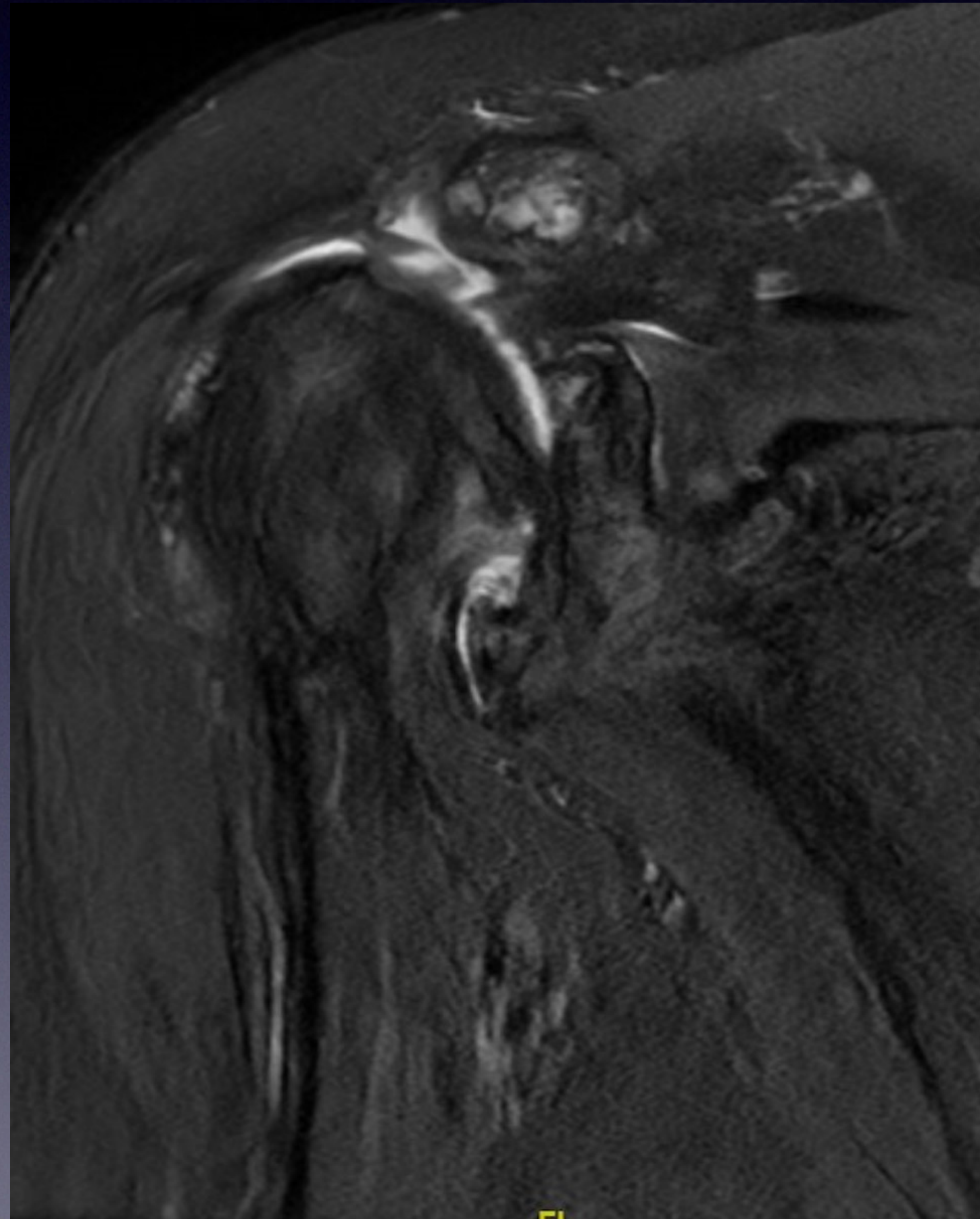
SCR 1 año

- Mujer 78 años
- CONSTANT PREOP- 31
- Distancia acromio-humeral PREOP- 0,19 cm



-CONSTANT 1 AÑO- 53

-Distancia acromio-humeral—0,1 cm





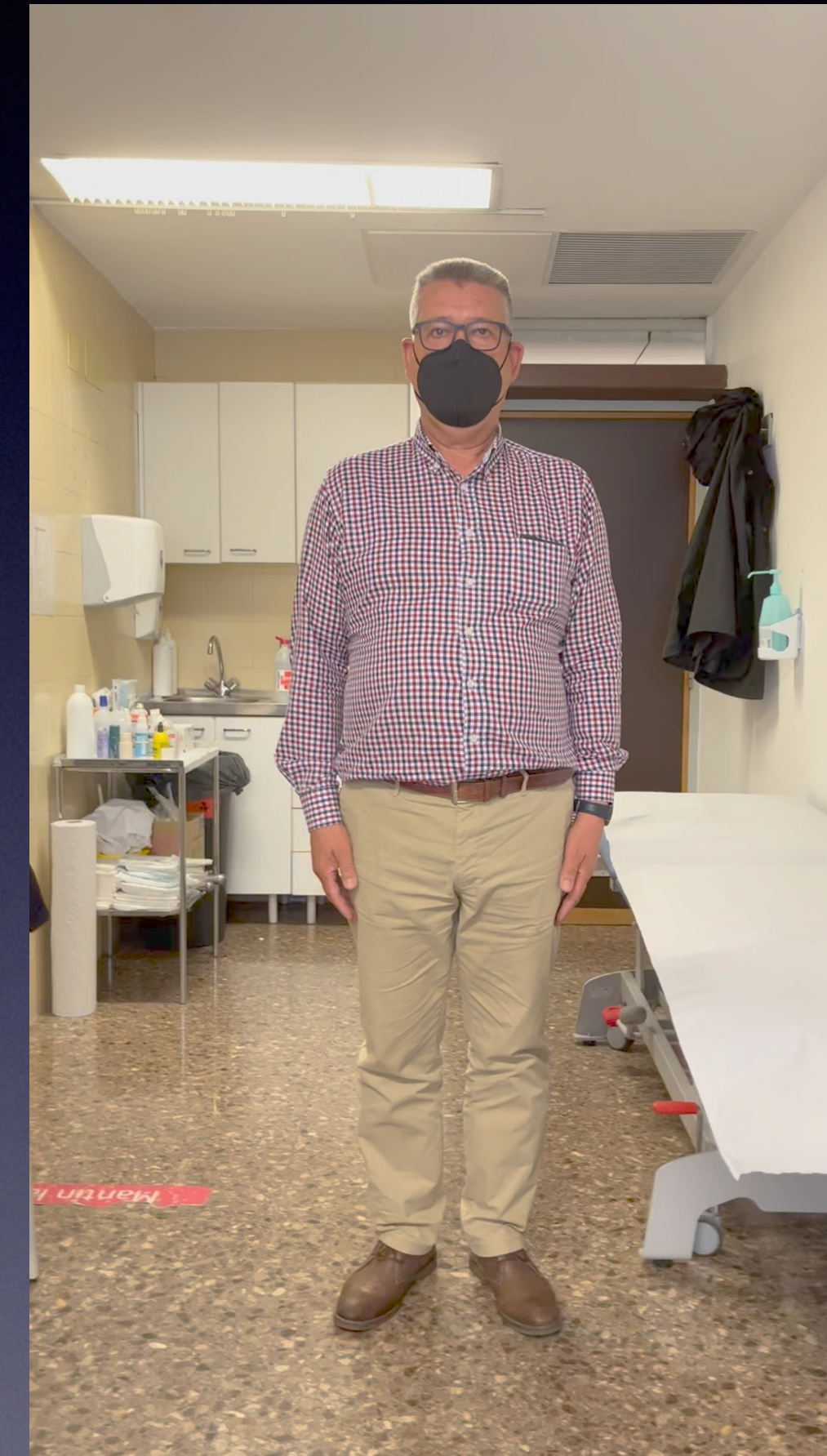
1 año- HAMADA 3

CASO CLINICO 3

SCR 6 meses

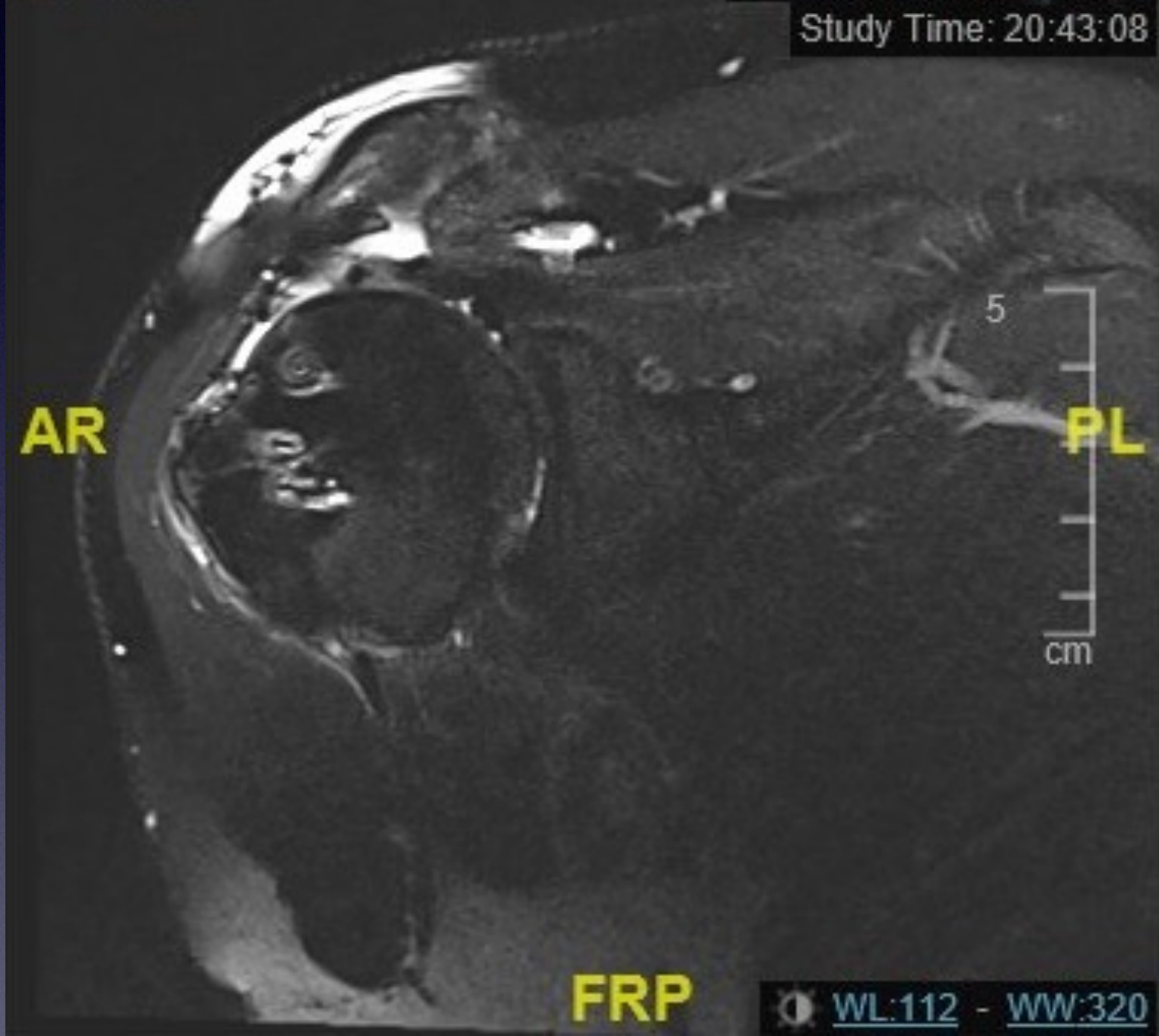
- Varón 60 años
- CONSTANT PRE- 58
- Distancia acromio-humeral—0,98cm

- CONSTANT 6 meses- 91
- Distancia acromio-humeral—0,28cm



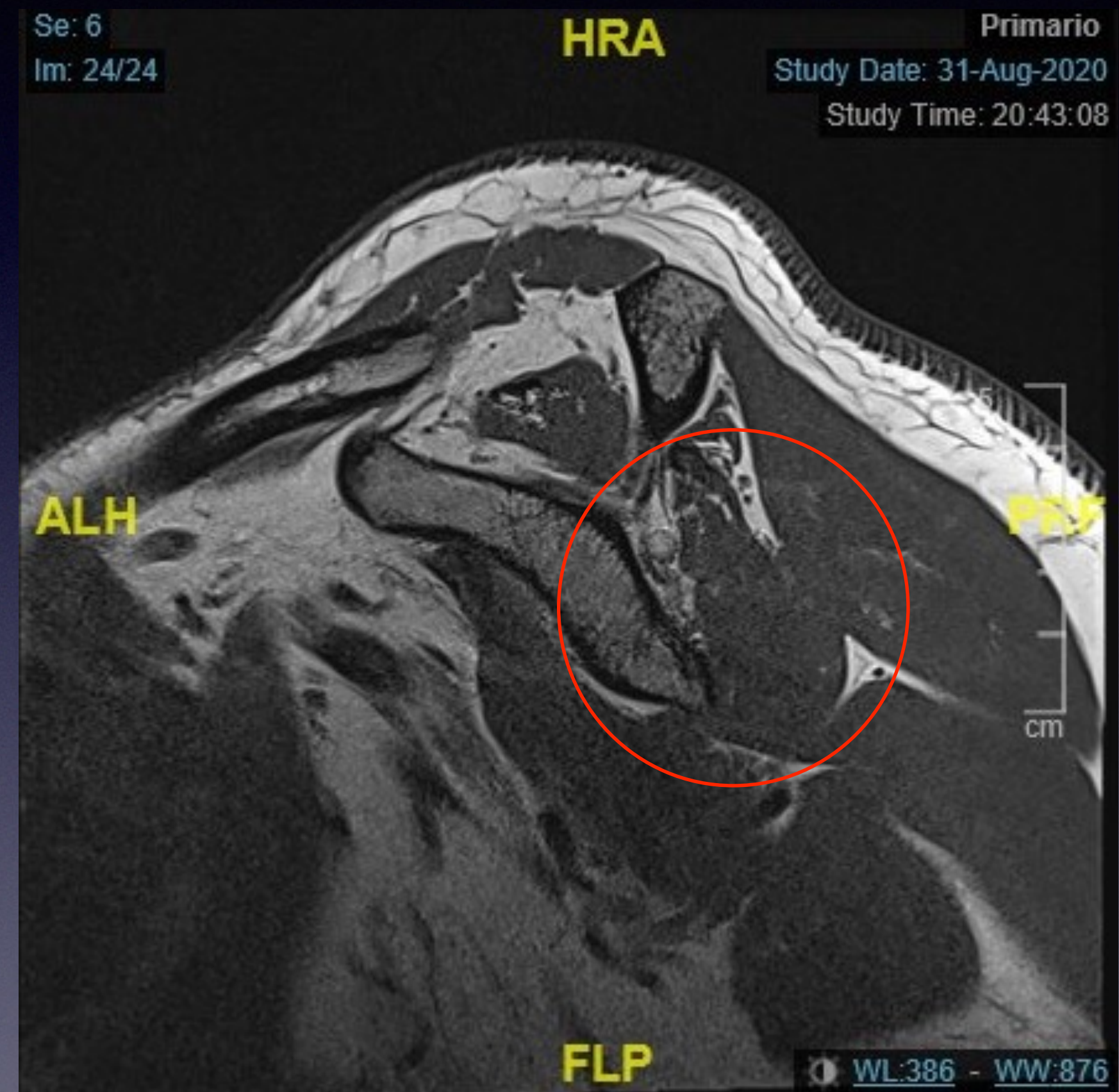
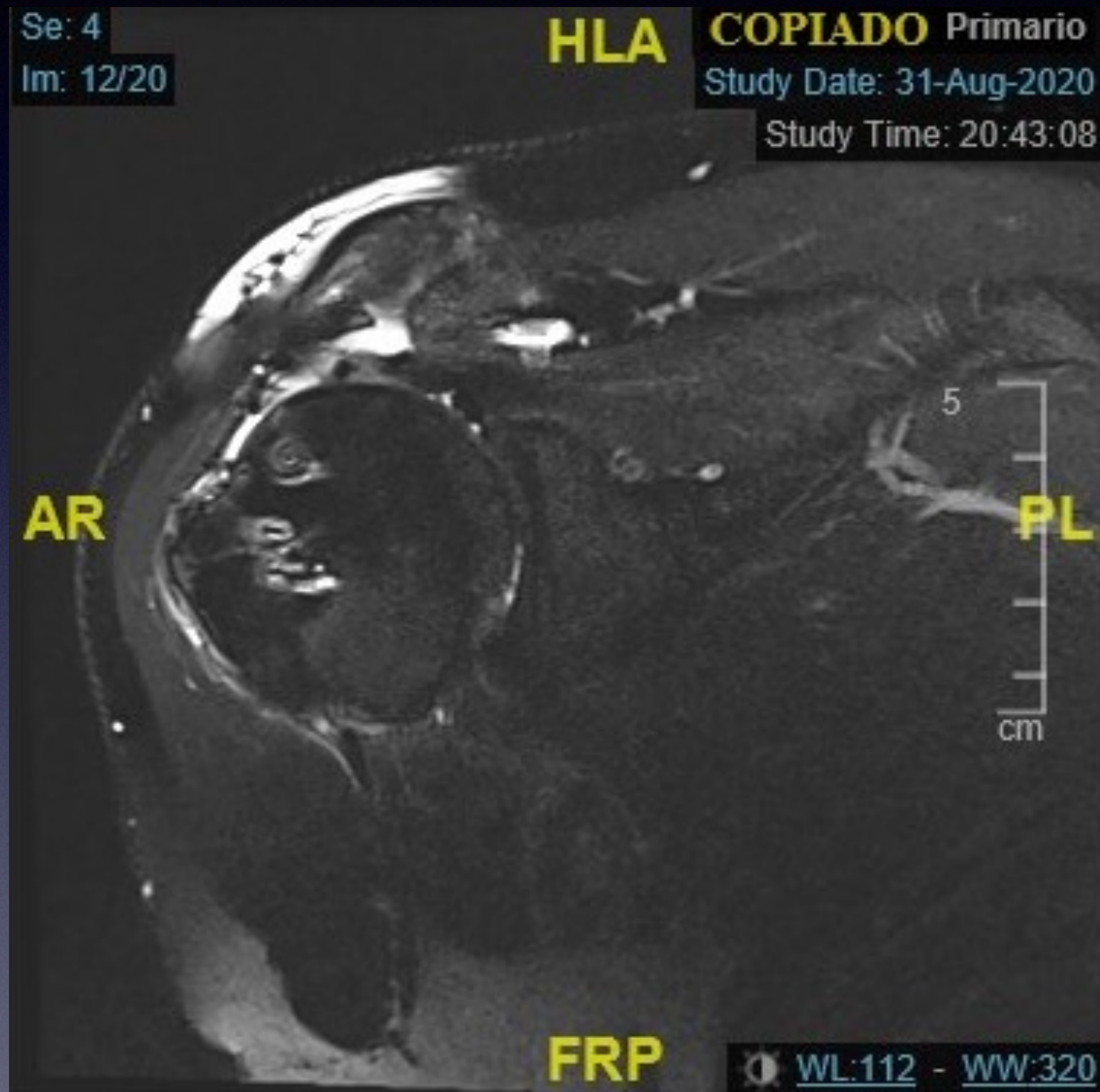
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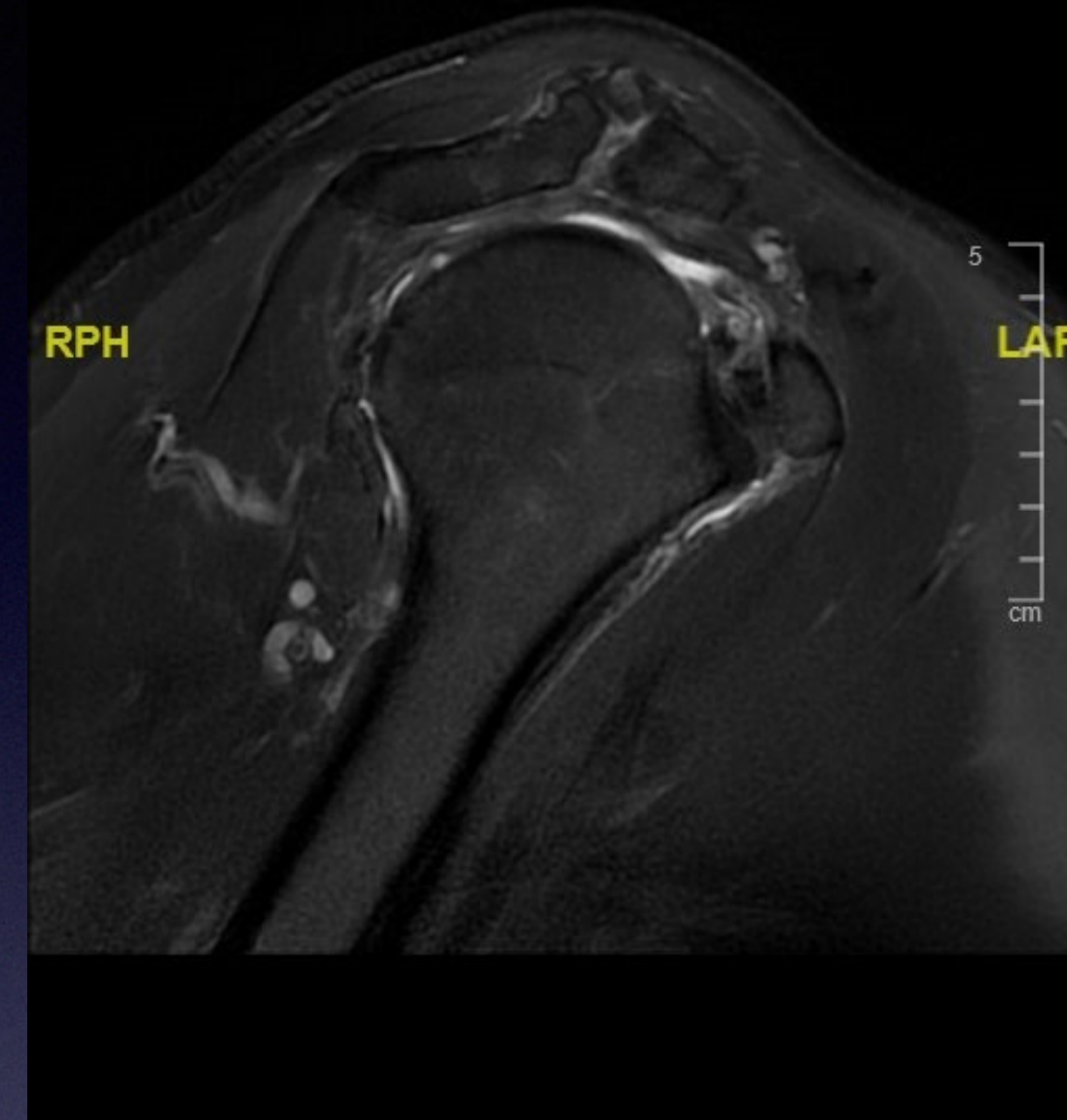
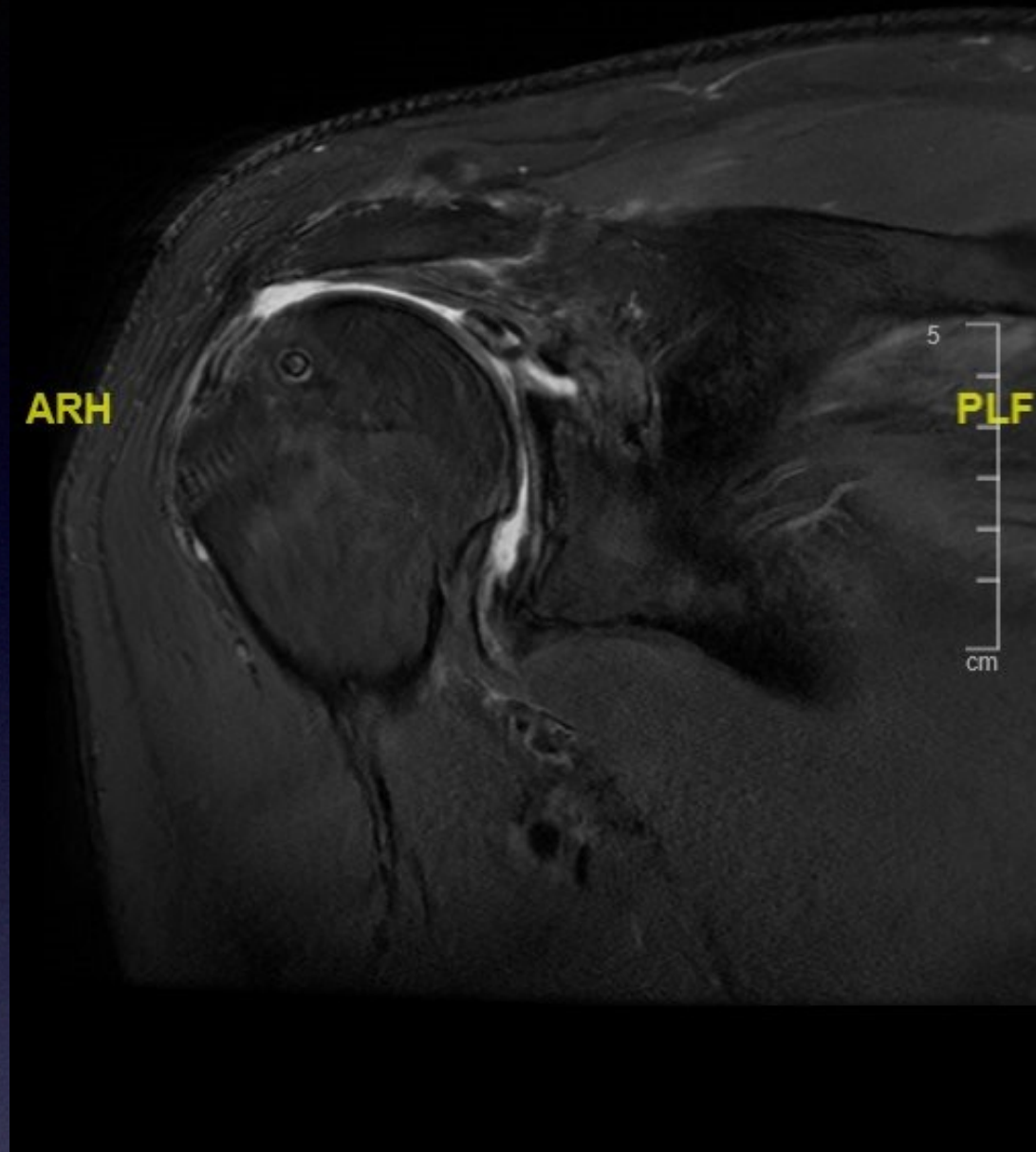
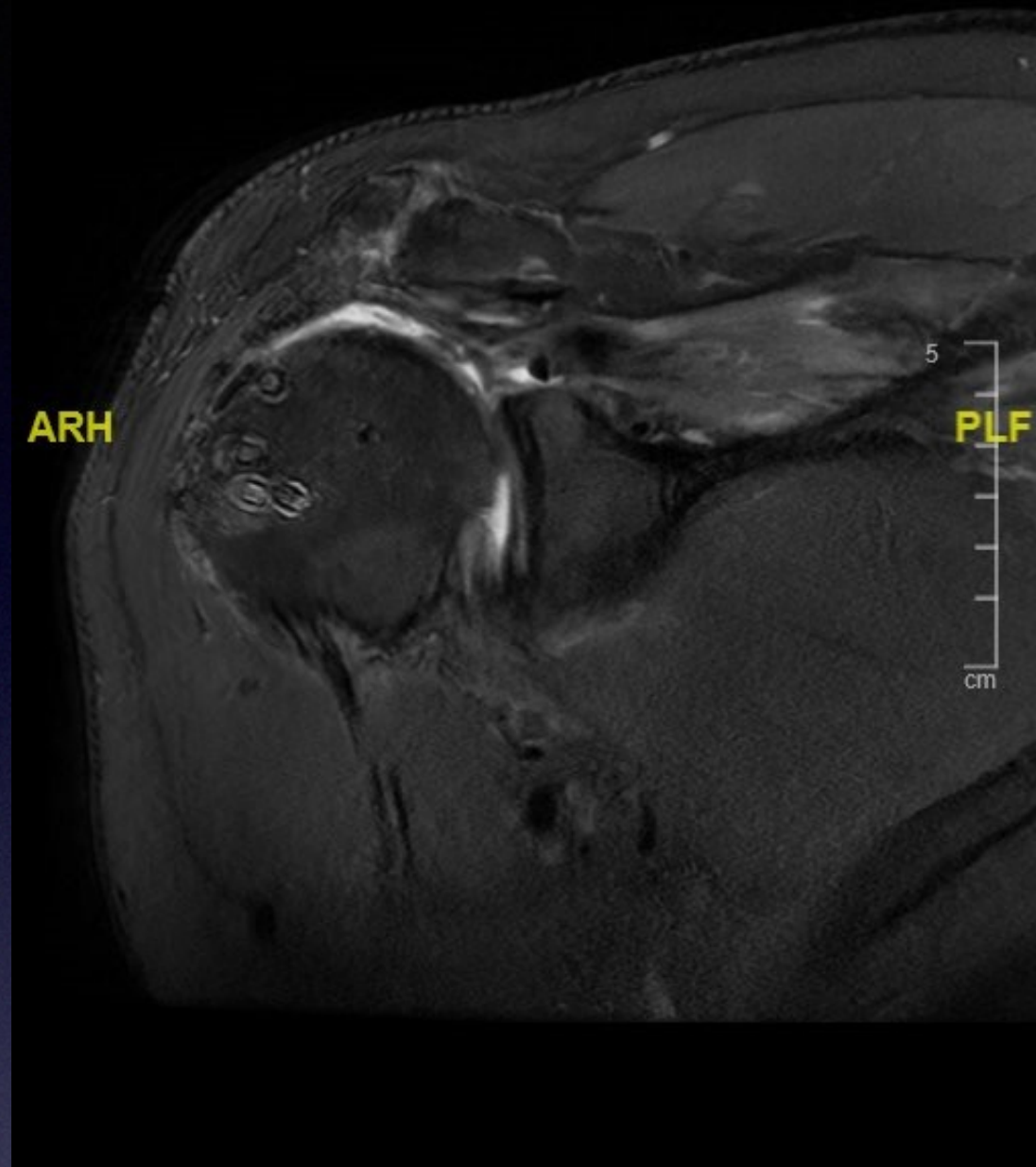
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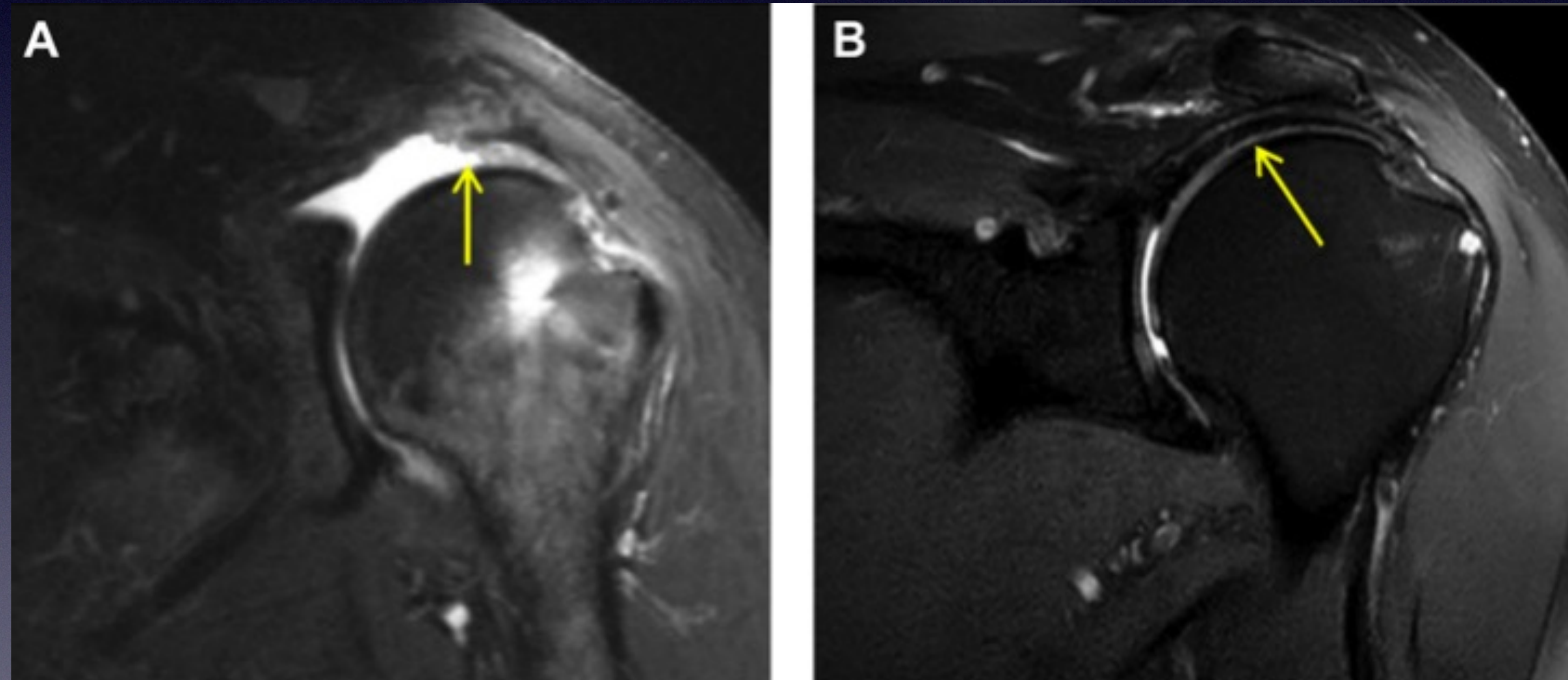




RM POSTOP



¿Por qué fracasa la SCR?



ARTICLE IN PRESS

Superior Capsular Reconstruction Using Dermal Allograft Is a Safe and Effective Treatment for Massive Irreparable Rotator Cuff Tears: 2-year Clinical Outcomes

Troy D. Pashuck, M.D., Alan M. Hirahara, M.D., James L. Cook, D.V.M., Ph.D.,
Cristi R. Cook, D.V.M., M.S., Wyatt J. Andersen, M.S.H.S., A.T.C., and
Matthew J. Smith, M.D.

Purpose: To evaluate functional, symptomatic, and diagnostic imaging outcomes after arthroscopic superior capsular reconstruction (SCR) using dermal allograft in patients with massive irreparable rotator cuff tears. **Methods:** From 2015 to 2017, this multicenter study retrospectively evaluated patients undergoing arthroscopic SCR for treatment of symptomatic massive rotator cuff tears. Study criteria included the presence of a massive irreparable rotator cuff tear with retraction to the glenoid without diffuse bipolar cartilage loss, Grade 4 or 5 Hamada classification, and subscapularis pathology that could not be addressed. All SCR procedures were performed with neutral abduction of the arm at the time of implantation. Outcome measures included visual analog pain scale (VAS) score, the American Shoulder and Elbow Surgeons (ASES) score, Single Assessment Numeric Evaluation (SANE) score, and active forward elevation (FE) through 2 years postoperatively. Imaging analyses included radiographs, ultrasound, and magnetic resonance imaging at 6 months and 1 year. **Results:** Fourteen patients met all study criteria including required follow-up. There were statistically significant improvements in VAS pain (3.3-0.6, $P = .001$), ASES (55.0-86.5, $P < .0001$), SANE (33.1-71.5, $P < .0001$), and active FE (128-172, $P = .0005$) with mean follow-up of 2.1 years. Twelve patients (86%) met the minimum clinically important difference in VAS pain, ASES, and SANE. Thirteen grafts (93%) had ultrasonographic evidence for vascularity by 1 year postoperatively. There were 2 graft complications (14%) with one (7%) requiring revision to reverse total shoulder arthroplasty. **Conclusions:** Arthroscopic SCR using dermal allograft can be a safe and effective treatment option for patients with massive irreparable rotator cuff tears with statistically significant improvements in VAS pain, ASES, SANE, and active FE at 2-years postoperatively, with 93% of grafts demonstrating vascularity at 1-year postoperatively.

From the Department of Orthopaedic Surgery (T.D.P., J.L.C., C.R.C., M.J.S.), Laboratory for Regenerative Orthopaedics (J.L.C., C.R.C., M.J.S.), and Mizou BioJoint Center (J.L.C., C.R.C., M.J.S.), University of Missouri, Columbia, Missouri; and Private Practice, Sacramento, California (A.M.H., W.J.A.), U.S.A.

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the submitted work. In addition, J.L.C. has a patent (U.S. Patent #10,039,277) with royalties paid from the Musculoskeletal Transplant Foundation. A.M.H. reports grants from Arthrex, during the conduct of the study; and grants and personal fees from Arthrex, other from Clarus Mobile Health, and personal fees from LifeNet Health, outside the submitted work. T.D.P. reports grants from Arthrex, during the conduct of the study. M.J.S. reports grants from Arthrex, during the conduct of the study; and grants and personal fees from Arthrex, personal fees from DePuy Synthes, personal fees and other from Lynite Orthopaedics, and grants from Wright Medical Technology, outside the submitted work. Full ICMJE author disclosure forms are available for this article online, as supplementary material.

Authors J.L.C. and C.R.C. are husband and wife.
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Arthroscopy: The Journal of Arthroscopic and Related Surgery, Vol ■, No ■ (Month), 2020: pp 1-8

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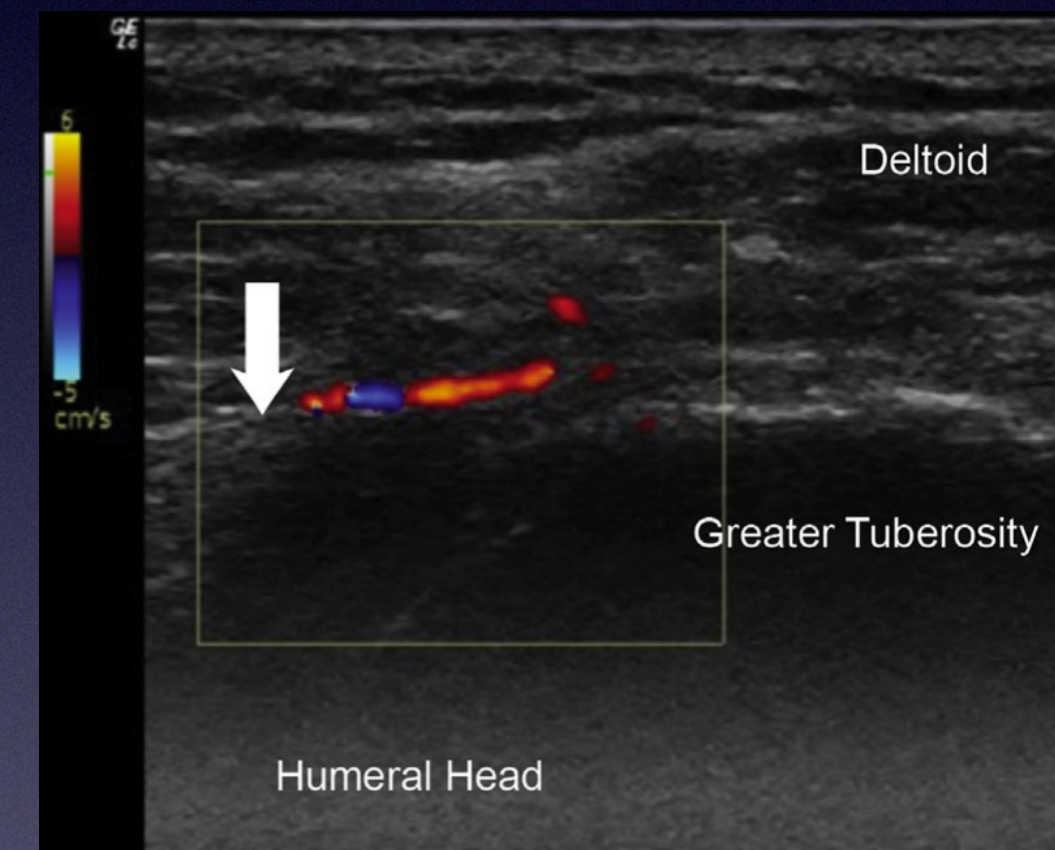
- Pashuck, Hirahara, Cook, Cook, Andersen, Smith
 - Arthroscopy, Oct 2020
 - 2015-2017, Multicenter, 14 pts.
 - Sig imp VAS, ASES, SANE, FE
 - 93% had vascularity by 1 yr on U/S
 - 1 Revised to RSA

Arthroscopy
The Journal of Arthroscopic
and Related Surgery
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OF NORTH AMERICA

Arthroscopic SCR using dermal allograft can be a safe and effective treatment option for patients with massive irreparable rotator cuff tears with **statistically significant improvements in VAS pain, ASES, SANE, and active FE at 2-years** postoperatively.

With **93% of grafts demonstrating vascularity at 1-year** postoperatively.

Neutral abduction of the arm at the time of implantation resulted in positive clinical outcomes and may **decrease graft failure rate.**



J Shoulder Elbow Surg (2021) 30, 2041–2047




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Evaluating the role of graft integrity on outcomes: clinical and imaging results following superior capsular reconstruction

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Background: Superior capsular reconstruction (SCR) addresses massive, irreparable rotator cuff tears in young patients. The purpose of this study was to retrospectively evaluate clinical outcomes and graft integrity in patients following SCR.

Methods: Thirty-four consecutive patients undergoing SCR by 2 surgeons with minimum 2-year follow-up were identified. Functional outcomes were obtained, including Simple Shoulder Test (SST), American Shoulder and Elbow Surgeons Standardized Shoulder Assessment Form (ASES), visual analog scale (VAS), and Single Assessment Numeric Evaluation (SANE) scores. Graft integrity was evaluated on magnetic resonance images (MRIs).

Results: Thirty-five shoulders in 34 patients were identified. Four patients underwent subsequent surgery. The mean preoperative scores were SST 21.6 ± 17.6, ASES 28.3 ± 10.1, SANE 50.6 ± 22.1, and VAS 6.6 ± 1.7. The mean postoperative outcomes were SST 79.1 ± 19.6, ASES 79.9 ± 17.4, SANE 74.3 ± 18.7, and VAS 1.5 ± 2.2. There was statistically significant improvement in SST, ASES, and VAS following SCR. MRI revealed graft failure in 62% (n = 13 of 21) of shoulders. Radiographic evidence of graft healing did not have any effect on SST, ASES, SANE, or VAS scores.

Conclusion: Given the high rate of graft failure without a significant difference in clinical outcomes, graft healing after SCR might not be an independent predictor of success. The improved clinical improvement in patients undergoing SCR may be due to other known beneficial aspects of the procedure, including partial rotator cuff repair, débridement, and biceps management.

Level of Evidence: Level III; Retrospective Cohort Comparison; Treatment Study

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Keywords: superior capsular reconstruction; massive rotator cuff tear; graft integrity; MRI; functional outcomes; pain and function

Institutional review board approval was received from University Hospitals (Study 20191591) and Lake Health.

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Rotator cuff repair is one of the most common procedures performed in the United States, with more than 500,000 repairs completed annually.¹ Although return to baseline status is achievable for most patients, predisposing factors toward poor outcomes include degree of tear, quality of the tissue, age, and smoking.^{2,3} Irreparable tears tend to be larger in size and classically have inelasticity

35 hombros
21 RM

FALLO DEL INJERTO (13) 62%

Marcada **mejoría** en resultados funcionales y escalas de dolor

Table II Comparison of pre- and postoperative functional outcomes

Graft status	SST	ASES	VAS	SANE
Intact graft	86.4 ± 13.3	88.5 ± 10.5	0.7 ± 1.1	78.4 ± 20.0
Torn graft	78.7 ± 26.7	74.3 ± 21.7	2.3 ± 2.2	69.8 ± 21.3
P value	.47	.12	.09	.4

SST, Simple Shoulder Test; ASES, American Shoulder and Elbow Surgeons Standardized Shoulder Assessment Form; VAS, visual analog scale; SANE, Single Assessment Numeric Evaluation.

EVIDENCIA RADIOGRAFICA DE CICATRIZACION DEL INJERTO- No tiene ningún efecto en los resultados funcionales y de dolor

Evaluating the role of graft integrity on outcomes: clinical and imaging results following superior capsular reconstruction. **Mark W. LaBelle, MD**, et al.

J Shoulder Elbow Surg (2021) 30, 2041–2047

Superior Capsular Reconstruction for the Operatively Irreparable Rotator Cuff Tear: Clinical Outcomes Are Maintained 2 Years After Surgery

Stephen S. Burkhart, M.D., Joel J. Prankun, D.O., and Robert U. Hartzler, M.D., M.S.

Purpose: To evaluate the results of arthroscopic superior capsular reconstruction (SCR) after 2-year minimum follow-up and to compare the results with those seen in a previously studied group of patients at 1 year postoperatively. **Methods:** The retrospective study period was October 2014 through September 2016. Inclusion criteria were arthroscopic dermal allograft SCR performed for operatively irreparable posterosuperior rotator cuff tear with intact or repairable subscapularis tendon, failure of nonoperative treatment, and clinical follow-up at 1 and minimum 2 years postoperatively. Patients lost to follow-up or undergoing revision of the SCR were excluded from the analysis. The primary outcome measure was American Shoulder and Elbow Surgeons (ASES) score (mean, [95% confidence interval], *P* value). Secondary outcomes included visual analog pain rating (0-10), subjective shoulder value, and active forward elevation and external rotation (degrees). Radiographic analysis included acromiohumeral interval (millimeters) and graft integrity 1-year postoperation. Complications and reoperations were reviewed from the medical record. **Results:** Forty-one patients met inclusion criteria at mean 34 months postoperatively, and 8 were excluded. ASES score improved from 52 (46-57) preoperative to 90 (87-92; *P* < .0001) and 89 (86-92; *P* < .0001) at 1-year postoperation and at final follow-up without diminishing in the interim (*P* = .9). All secondary clinical outcomes improved from preoperative to final follow-up. Subjective shoulder value diminished 5% between 1 year and final follow-up (*P* = .03), whereas active external rotation improved 11° during this time (*P* = .02). In total, 85% of grafts were fully healed, with acromiohumeral interval improved from 7 (6-8) mm to 8 mm (7-9; *P* = .04). There were 2 (5%) revisions and 6 (14%) failures to reach the minimally clinically important improvement in ASES score: a 19% rate of unsatisfactory outcomes. There was an additional 1 reoperation (2%) and 1 (2%) medical complication. **Conclusions:** Arthroscopic joint preservation surgery for massive, operatively irreparable posterosuperior rotator cuff tears with dermal allograft SCR and associated procedures results in improved clinical outcomes that are durable between 1 and minimum 2-year follow-up. **Level of Evidence:** IV retrospective case series.

Superior capsular reconstruction (SCR) with fascia lata autograft initially was developed by Mihata et al.^{1,2} as a joint-preserving option for patients with massive,

irreparable rotator cuff tears who did not have glenohumeral arthritis. Hirahara and Adams³ first proposed the use of dermal allograft for SCR instead of fascia lata autograft. The senior author has been performing SCR with dermal allografts since October 2014, with more than 150 SCRs performed during that time.

A preliminary report of short-term (1-year) outcomes by Denard et al.⁴ demonstrated encouraging results, as did another study of short-term SCR results by Pennington et al.⁵ The authors also analyzed at 1-year follow-up a subgroup of patients with profound loss of forward elevation, with the vast majority regaining active overhead motion after SCR.⁶ However, there is currently a paucity of literature to support the durability of SCR results beyond 1 year.⁷

The purpose of this study was to evaluate the results of arthroscopic SCR after 2-year minimum follow-up and to compare the results with those seen in a previously studied group of patients at 1 year postoperatively. The

41 pacientes-Dermal allograft

Table 2. Pre- and 1-Year Postoperative Radiographic Data for the 41 Study Patients

Number of patients (shoulders)	41
Postoperative MRI	26 (63%)
MRI complete healing	22 (85%)
MRI partial healing	1 (4%)
MRI complete graft disruption	3 (11%)
Postoperative radiographs	32 (78%)
Preoperative AHI, mm	7 ± 0.4 [6-8]
Postoperative AHI, mm	8 ± 0.4 [7-9]
Δ AHI	1 ± 0.5 [-0.2 to 2]

85% de injertos íntegros -1 año
INTERVALO Acromion-Humeral incremento 1mm-1 año

6 S. S. BURKHART ET AL.

Table 3. Clinical Results of 41 Patients Undergoing SCR at Minimum 2-Year Follow-Up

Outcome Measures	Preoperative	1-Year Postoperative	<i>P</i> *	2-Year Postoperative	<i>P</i> †	<i>P</i> ‡
ASES score (0-100)	52 [46-57]	90 [87-92]	<.0001	89 [86-92]	.9	<.0001
VAS pain (0-10)	4.6 [3.8-5.4]	0.5 [0.2-0.7]	<.0001	0.7 [0.4-1]	.2	<.0001
SSV (0-100)	39 [33-44]	88 [85-92]	<.0001	83 [79-87]	.03	<.0001
Active FE, °	140 [120-159]	172 [168-176]	.002	167 [159-176]	.5	.006
Active ER, °	37 [29-44]	48 [42-53]	.002	59 [51-67]	.02	<.0001

From The San Antonio Orthopaedic Group (TSAOG) Orthopaedics, San Antonio; and Baylor College of Medicine, Houston, Texas, U.S.A.
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Superior capsular reconstruction: 2-year follow-up results

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ARTICLE INFO

Keywords:

Shoulder
superior capsular reconstruction
rotator cuff
chronic tendon rupture
arthroscopy

Level of Evidence: Level IV; Case Series;
Treatment Study

Introduction: A prerequisite for a satisfying functional result in the treatment of an irreparable rotator cuff rupture is a significant reduction of shoulder pain and better range of motion with an increase in anatomic glenohumeral joint stability.

Purpose: Prospective study to examine the outcome after superior capsular reconstruction using a porcine extracellular matrix dermal graft. A special emphasis was primarily on the functional outcome, secondarily on radiographic shoulder changes, that superior capsular reconstruction might yield.

Methods: Clinical results were evaluated using the Constant score and Western Ontario Rotator Cuff (WORC) index over a 2-year period. All patients had magnetic resonance imaging (MRI) of the injured shoulder after 1 year. Graft integration and durability were qualitatively estimated as well as any graft deterioration or resorption.

Results: Thirteen patients with 13 superior capsular reconstructions were included over a 3-year period. Mean age was 61 years (range 50-70) at the time of surgery. At final follow-up (mean 24 months, range 23-32), the mean Constant score had improved from an average of 24.9-55.7 points. The mean WORC index had increased from a percentage average of 32.3%-61.9%. Eleven of 13 grafts were intact on follow-up MRI.

Conclusion: Our hypothesis was that successful implantation of a dermal xenograft would correlate with both better functional outcome and stabilized glenohumeral radiographic features. We saw a group of patients with variable but significant increases in functional results and in general with limited pain and with an intact xenograft on an MRI scan. We did not find a positive correlation between functional outcome scores and graft durability nor with single cuff tendon defects vs. larger rotator cuff defects. This study suggests that a superior capsular reconstruction can yield results that are comparable or superior to other known salvage treatment options in patients with large to massive rotator cuff defects without significant cuff tear arthropathy. The hypothesis that superior capsular reconstruction can be a relevant treatment method for irreparable rotator cuff tears could not be refuted despite a fairly low patient inclusion number. With these results, selected patients can be considered for a different treatment than reverse shoulder arthroplasty, débridement, or tendon transfer.

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A great number of patients with a chronic irreparable superior rotator cuff rupture seek treatment.^{2,31} An irreparable superior rotator cuff rupture can be evaluated on a magnetic resonance imaging (MRI) scan showing retraction of a tendon remnant to the glenohumeral joint line with fatty degeneration grade 3 or 4 according to Goutallier and atrophy of the rotator cuff muscle under the tangent line according to Gerber.^{13,15,28} Such a defect can also be evaluated with shoulder arthroscopy where the tendon remnant typically is found to be rigid, leaving a large defect in the upper part of the rotator cuff.

During shoulder abduction, this contributes to instability with cranial displacement of the glenohumeral fulcrum and collision of the humeral head against the underside of the acromion.^{20,28} Attempts to mobilize retracted tendon tissue with interval slides^{12,19,20} must often be abandoned, or sometimes only a single-row fixation of a tight supraspinatus tendon can be achieved. According to Burkhart, it is possible to surgically close these chronic defects in at least 70% of cases.²⁰ Other sources describe these defects more often as being irreparable²³ and recommend that repair of retracted ruptured supraspinatus tendons >3 cm should not be attempted.^{18,27} Typically, symptoms are pain, loss of strength, and active range of motion reduced to <90° abduction. Conservative treatment such as supervised strengthening of the deltoid muscle and the remaining posterior rotator cuff can yield some pain alleviation, especially for patients aged ≥70 years,

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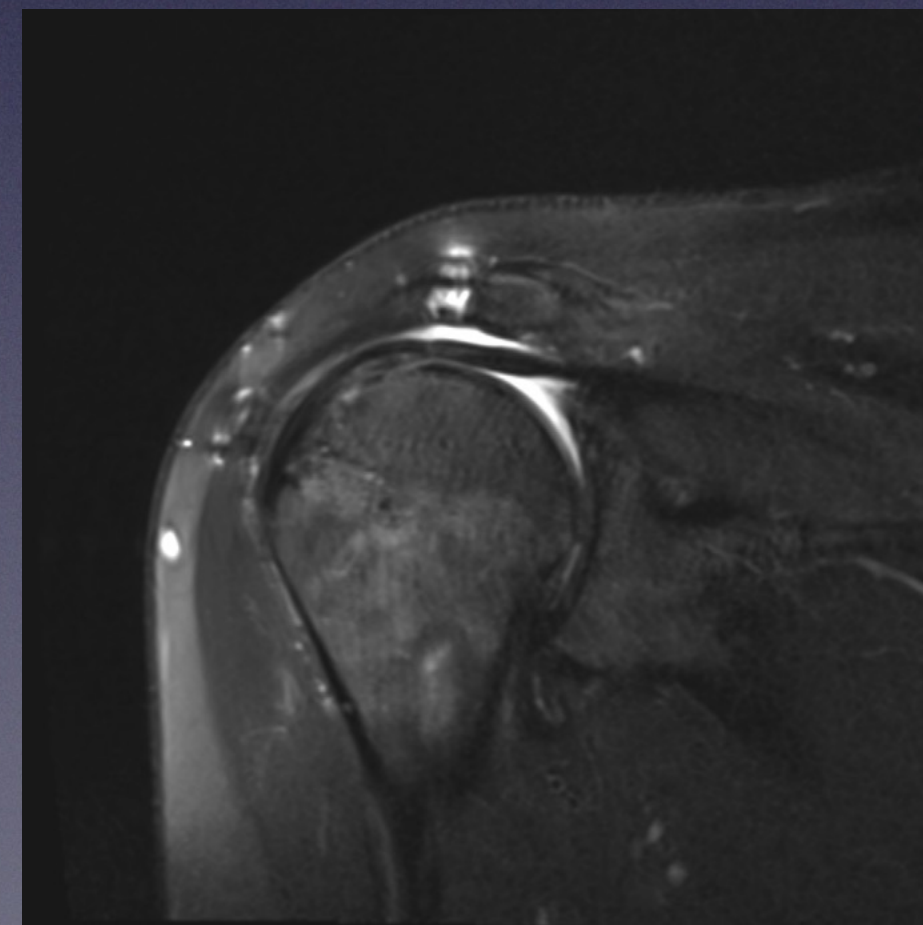
<https://doi.org/10.1016/j.jseint.2020.06.012>
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Table II
Patients and results

Case no.	Sex	Age at operation (yr)	Size of tendon defect*	Constant score/ WORC index, preoperative	Constant score, 6 mo postoperative	Constant score/ WORC index, 12 mo postoperative	MRI scan, 12 mo postoperative ¹	Constant score/ WORC index, 24 mo, postoperative	Clinical outcome based on patient satisfaction/ percent increase in Constant score and WORC index preoperatively to final follow-up
1	F	54	SS+IS	20/8.2%	26	71/56.1%	Intact graft at 12 mo	38/47.9%	Painfree Satisfied Constant score increase: 90% WORC index increase: 484% Not satisfied. RSA implanted after 2.5 yr Constant score increase: 0% WORC index increase: 0%
2	F	50	SS	25/51.4%	29	14/21.9%	Intact graft at 12 mo	15/22.0%	The patient was noncompliant. He was satisfied with his end result. Constant score increase: 222% WORC index increase: 101%
3	M	61	SS	22/31.0%	9/	51/70.9%	Graft ruptured at 5 mo	71/62.4%	Painfree Satisfied Constant score increase: 268% WORC index increase: 196% Constant score increase: 266% WORC index increase: 245% Constant score increase: 93% WORC index increase: 164% Constant score increase: 82% WORC index increase: 85%
4	M	61	SS+IS	19/25.0%	75/	90/73.1%	Intact graft at 12 mo	70/74.0%	Constant score increase: 163% WORC index increase: 31% Constant score increase: 62% WORC index increase: 5%
5	M	55	SS+IS	21/22.9%	21	57/58.1%	Intact graft at 7 mo	77/79.1%	Constant score increase: 104% WORC index increase: 400% Constant score increase: 92% WORC index increase: 59%
6	F	61	SS+IS	30/31.7%	37	39/66.3%	Intact graft at 16 mo	58/83.6%	Constant score increase: 194% WORC index increase: 132% Constant score increase: 121% WORC index increase: 87%
7	M	70	SS	41/39.0%	59	62/85.9%	Intact graft at 11 mo	75/72.2%	
8	M	68	SS+IS	19/43.9%	20	51/54.4%	Intact graft at 13 mo	50/57.5%	
9	M	63	SS	22/49.1%	20	36/35.1%	Intact graft at 13 mo	35/51.7%	
10	M	60	SS+IS	25/10.2%	46	55/47.3%	Intact graft at 12 mo	51/51.0%	
11	M	70	SS	24/38.2%	42	40/55.4%	Intact graft at 12 mo	46/60.9%	
12	M	54	SS	19/28.0%	37	65/29.6%	Graft ruptured at 3 mo	6/65.0%	
13	M	63	SS	37/41.5%	43	56/73.1%	Intact graft at 13 mo	82/77.7%	

F, female; M, male; SS, supraspinatus tendon; IS, infraspinatus tendon; WORC, Western Ontario Rotator Cuff; MRI, magnetic resonance imaging; CS, Constant score; RSA, reverse shoulder arthroplasty.
* When a total or a subtotal rupture of an infraspinatus tendon was identified besides a supraspinatus tendon rupture, this was defined as a 2-tendon defect whether the infraspinatus rupture could be repaired or not.
¹ Tendon status, graft durability, any graft retraction and grading of glenohumeral arthrosis.

13 SCR
24 meses de seguimiento
CONSTANT PRE- 24,9
CONSTANT POST- 55,7
11-injertos íntegros en RM



A.Ulstrup et all. JSES 2020

CORRELACION ENTRE MEJORIA FUNCIONAL Y DOLOR E INTEGRIDAD DEL INJERTO

Arthroscopic Superior Capsular Reconstruction for Older Patients With Irreparable Rotator Cuff Tears

A Comparative Study With Younger Patients

Erica Kholinne,* MD, PhD, Jae-Man Kwak,[†] MD, Chang-Ho Cho,[‡] MD, Khalid AISomali,[§] MD, Thanh Van Nguyen,^{||} MD, Hyojune Kim,[‡] MD, Kyoung-Hwan Koh,[‡] MD, PhD, and In-Ho Jeon,^{†¶} MD, PhD
Investigation performed at Asan Medical Center, Seoul, Republic of Korea

Background: Arthroscopic superior capsular reconstruction (ASCR) is a method for treating irreparable chronic rotator cuff tears. However, the extent to which ASCR can be performed with regard to the patient's age has yet to be determined.

Purpose: To compare the surgical outcomes of ASCR for the treatment of irreparable rotator cuff tears (IRCTs) in patients aged <65 years versus patients aged ≥65 years.

Study Design: Cohort study; Level of evidence, 3.

Methods: Of 105 patients with IRCTs who underwent ASCR between March 2013 and June 2020, 73 patients were enrolled in this study based on the selection criteria. Polypropylene mesh augmentation to the graft was used in 18 of 36 patients in the younger adults group (age, <65 years) and 20 of 37 patients in the older adults group (age, ≥65 years). The clinical and radiological outcomes were evaluated preoperatively and at the final clinical follow-up. The graft integrity status was evaluated using serial magnetic resonance imaging and set as the primary endpoint. Furthermore, subgroup analysis was performed based on age group and graft type.

Results: The mean age of the patients was 59.2 ± 3.8 years in the younger adults group and 70.5 ± 4.1 years in the older adults group. Both groups showed improvement based on the clinical and radiological outcomes at the final follow-up. The mean American Shoulder and Elbow Surgeons scores improved from 52.3 ± 15.4 to 77.3 ± 13.5 in the younger adults group ($P < .001$) and from 45.7 ± 16.1 to 76.6 ± 11.4 in the older adults group ($P < .001$). The mean visual analog scale for pain scores improved from 5.5 ± 1.2 to 2.1 ± 0.9 in the younger adults group ($P < .001$) and from 5.5 ± 1.4 to 2.1 ± 1.2 in the older adults group ($P < .001$). The graft healing rate was significantly higher in the younger adults group (81%) than in the older adults group (65%) ($P = .049$). Subgroup analysis showed that after mesh augmentation, the healing rate in the younger adults group (84%) was similar to that in the older adults group (85%) ($P = .299$).

Conclusion: ASCR resulted in a favorable surgical outcome for both younger and older adult patients with IRCT. The younger patients had lower graft failure rates and superior surgical outcomes. In older patients, ASCR using polypropylene mesh augmentation may reduce graft failure and result in surgical outcomes similar to those in younger patients.

Keywords: superior capsular reconstruction; younger adults; older adults; mesh; clinical outcome; radiological outcome

Irreparable rotator cuff tears (IRCTs) are difficult to treat because of a painful and dysfunctional shoulder. The healing rate of the repaired rotator cuff has been reported to be poor and is often associated with subsequent arthritic changes.¹⁶ Reverse total shoulder arthroplasty is a valuable option for treating IRCTs, despite the concerns regarding its longevity, particularly in the young active

population.⁴⁷ Considering this, joint-preserving surgeries such as debridement procedures, long head of the biceps tenotomies,⁵¹ tuberoplasties,⁴³ partial repairs,¹⁴ tendon transfers,¹⁷ and patch grafts¹ have been used for treatment. Moreover, arthroscopic superior capsular reconstruction (ASCR) using fascia lata autografts^{9,30,31,36,46,54} and allografts^{11,23,44,45} has been the preferred treatment option for the younger active population with IRCTs. Studies have shown good results since ASCR provide restoration of the biomechanics of the shoulder joint.^{35,40,48}

Systematic reviews have shown that the age of the pooled patients in studies reporting the clinical outcomes

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 DOI: 10.1177/03635465211024652
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2751

73 pacientes

2 grupos :

JOVENES (< 65): 36

MAYORES: 37

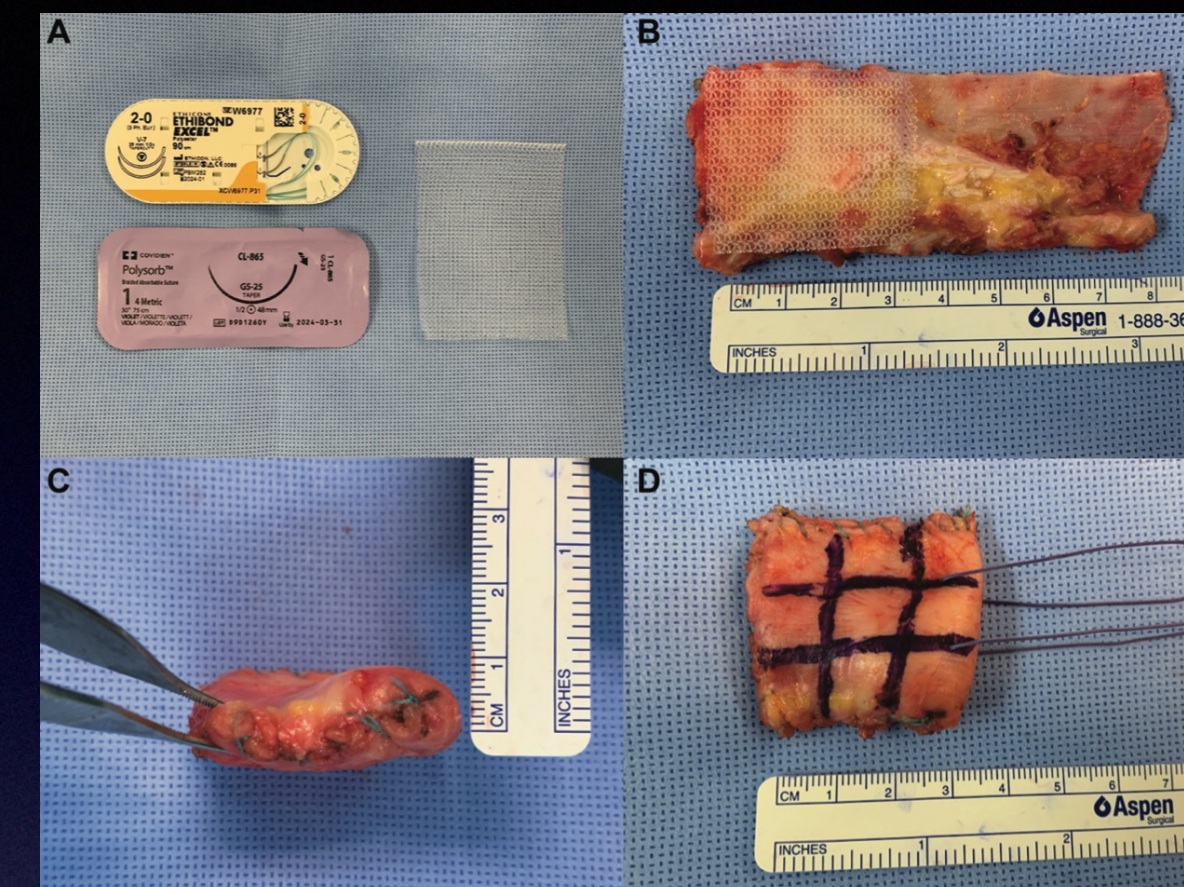
2 subgrupos:

Aumentación malla polipropileno

JOVENES: 18

MAYORES: 20

Mejores resultados y menos roturas del injerto en PACIENTES JOVENES
 En MAYORES menos fracasos de injerto con aumentación con malla y resultados quirúrgicos similares los jóvenes



Clinical Sports Medicine Update



Superior Capsule Reconstruction for Irreparable Massive Rotator Cuff Tears: Does It Make Sense?

A Systematic Review of Early Clinical Evidence

Burak Altintas,^{*†} MD, Michael Scheidt,[‡] BS, Victor Kremser,^{*} BS, Robert Boykin,[§] MD, Sanjeev Bhatia,^{||} MD, Kaveh R. Sajadi,[¶] MD, Scott Mair,^{*} MD, and Peter J. Millett,^{***} MD, MSc
Investigation performed at the University of Kentucky, Lexington, Kentucky, USA

Background: Treatment of irreparable massive rotator cuff tears (MRCTs) in patients without advanced glenohumeral osteoarthritis remains a challenge. Arthroscopic superior capsule reconstruction (SCR) represents a newer method for treatment with increasing popularity and acceptance.

Purpose: To analyze the clinical evidence surrounding SCR and determine the current clinical outcomes postoperatively.

Study Design: Systematic review.

Methods: A systematic review of the literature was performed following the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines. Electronic databases of PubMed, MEDLINE, Cochrane, and Google Scholar were used for the literature search. The study quality was evaluated according to the Modified Coleman Methodology Score. Studies in English evaluating SCR outcomes were included.

Results: Seven studies were reviewed, including 352 patients (358 shoulders) treated with arthroscopic SCR with the mean duration of follow-up ranging from 15 to 48 months (range, 12-88 months). Fourteen patients were lost to follow-up, leaving 338 patients (344 shoulders) with clinical outcome data. Graft types included dermal allografts (n = 3), fascia lata autografts (n = 3), or both (n = 1). Most commonly, a double-row technique was utilized for humeral graft fixation. The most common complication included graft tears in 13% of patients, resulting in 15 SCR revisions and 7 reverse shoulder arthroplasties. Postoperatively, improvements in visual analog scale (2.5 to 5.9), American Shoulder and Elbow Surgeons (20 to 56), Japanese Orthopaedic Association (38.0), Subjective Shoulder Value (37.0 to 41.3), and Constant (11.6 to 47.4) scores were observed. Three studies reported respective satisfaction rates of 72.9%, 85.7% and 90%. Increases in external rotation, internal rotation, and abduction with improved strength in external rotation were observed postoperatively. Improvement of pseudoparalysis was also observed in 3 studies. One study reported return to sports in 100% of patients (2 competitively, 24 recreationally) with no adverse outcomes.

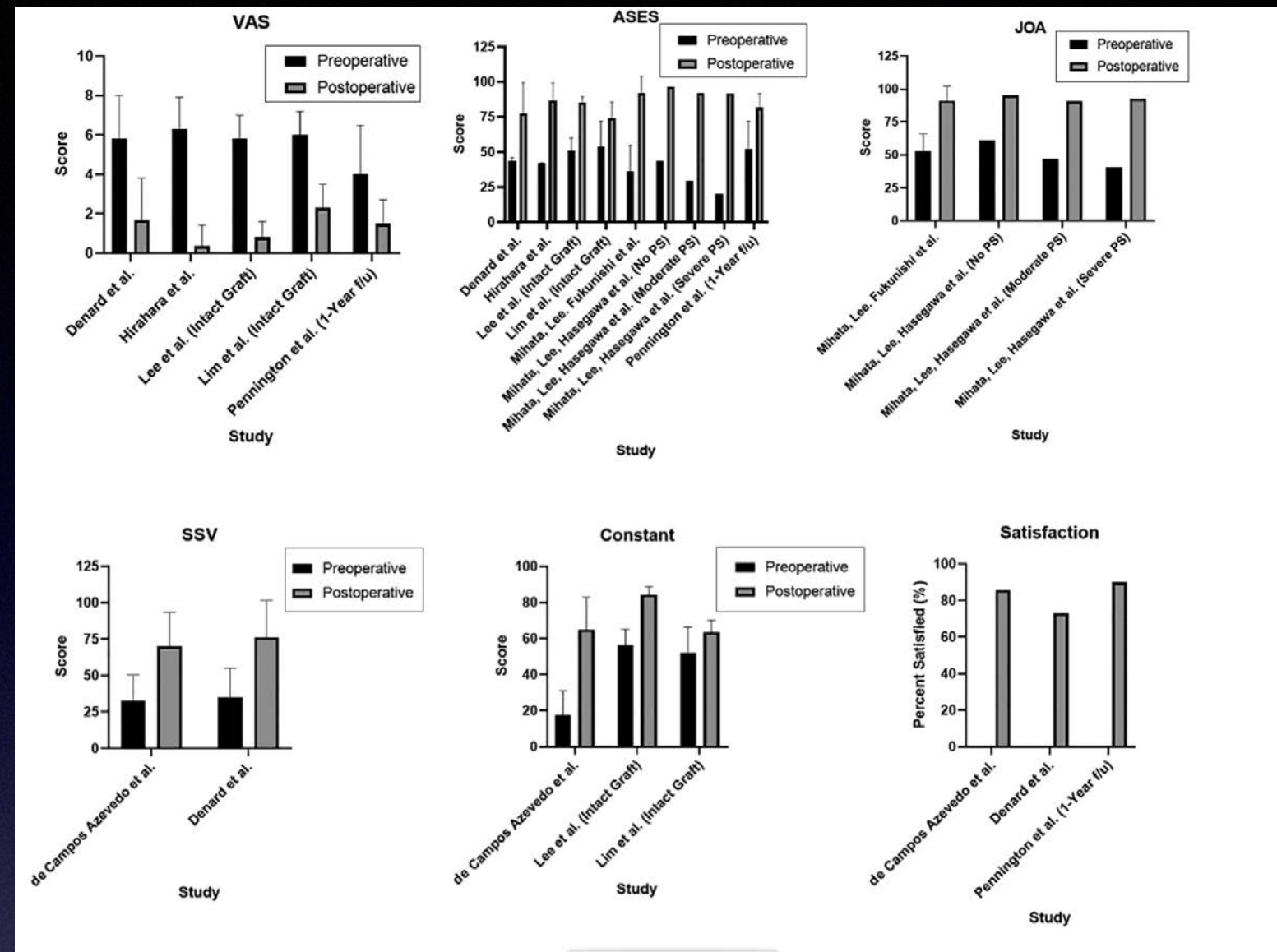
Conclusion: SCR showed good to excellent short-term clinical outcomes with adequate pain relief and functional improvement. The current evidence suggests that the procedure is an alternative for symptomatic patients with irreparable MRCT; however, the included studies were fair to poor in quality, and there were some notable complications. Long-term follow-up will determine the longevity and ultimate role of this new method in the treatment of irreparable MRCT.

Keywords: massive rotator cuff tear; irreparable; superior capsule reconstruction; arthroscopy

The management of massive rotator cuff tears (MRCTs) presents a treatment dilemma, especially in young patients with preserved glenohumeral cartilage. While most tears can be mobilized and repaired with adequate releases and modern surgical techniques, there is a subset of MRCT that is not amenable to repair. While the

definition of "irreparable" may vary, the ability for MRCT to heal remains a challenge, as chronic tears are commonly complicated by cranial migration of the humeral head,^{14,20,46} tendon inelasticity,³⁷ fatty infiltration of the musculature,^{1,24} and subsequent development of osteoarthritis.⁴⁷ The rate of retear has been shown to be higher with an acromiohumeral distance (AHD) <7 mm,⁴⁶ limiting the utility of primary repair. Historically, proposed treatment options for irreparable MRCT have ranged from nonoperative measures^{4,40} to surgical procedures, such as debridement^{19,23}; debridement with biceps tenotomy^{19,21}; tear augmentation or bridging of the tendon

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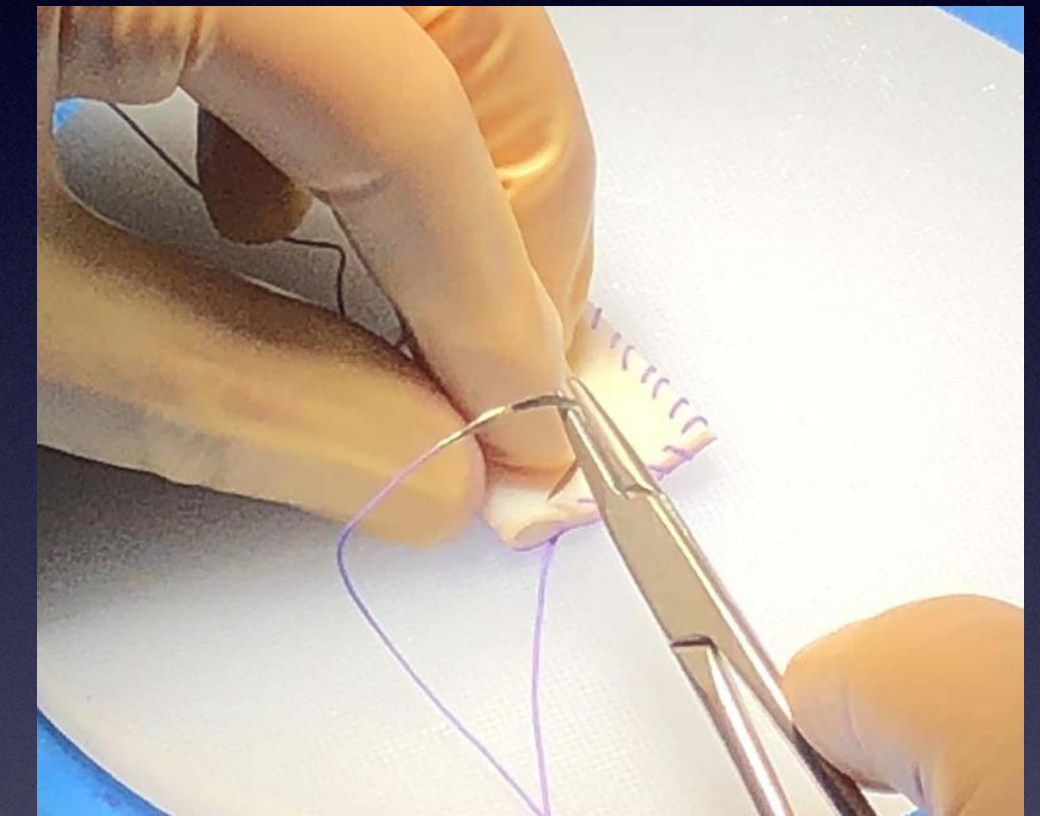


La complicación más común:
ROTURA DEL INJERTO
13%

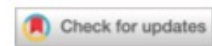
Marcada **mejoría** en **resultados funcionales y escalas de dolor** en pacientes con **ROTURA DEL INJERTO**

ROTURA DEL INJERTO

Poco grosor?
Doble capa?



Study Characteristics						
Study	Year	Design	Level of Evidence	Follow-up, mo, Mean ± SD or Range	Coleman Score	
de Campos Azevedo et al ⁵	2018	Retrospective case series	4	24	57	
Denard et al ⁶	2017	Retrospective case series	4	17.7 (12-29)	58	
Hirahara et al ¹⁷	2017	Retrospective case series	4	32.4 (25-39)	53	
Lee and Min ²⁰	2018	Retrospective case series	4	24.8 ± 6.9	52	
Lim et al ²²	2019	Retrospective case series	4	15 (12-24)	55	
Mihata et al ²⁶	2018	Comparative cohort study	3	48 (24-88)	58	
Mihata et al ²⁷	2018	Retrospective case series	4	60 (35-110)	57	
Pennington et al ³⁹	2018	Retrospective case series	4	12 ^a (16-28)	63	



Clinical Sports Medicine Update

Superior Capsule Reconstruction for Irreparable Massive Rotator Cuff Tears: Does It Make Sense?



A Systematic Review of Early Clinical Evidence

Burak Altintas,^{*,†} MD, Michael Scheidt,[‡] BS, Victor Kremser,^{*} BS, Robert Boykin,[§] MD, Sanjeev Bhatia,^{||} MD, Kaveh R. Sajadi,[¶] MD, Scott Mair,^{*} MD, and Peter J. Millett,^{***} MD, MSc
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Conclusion: SCR showed good to excellent short-term clinical outcomes with adequate pain relief and functional improvement. The current evidence suggests that the procedure is an alternative for symptomatic patients with irreparable MRCT; however, the included studies were fair to poor in quality, and there were some notable complications. Long-term follow-up will determine the longevity and ultimate role of this new method in the treatment of irreparable MRCT.

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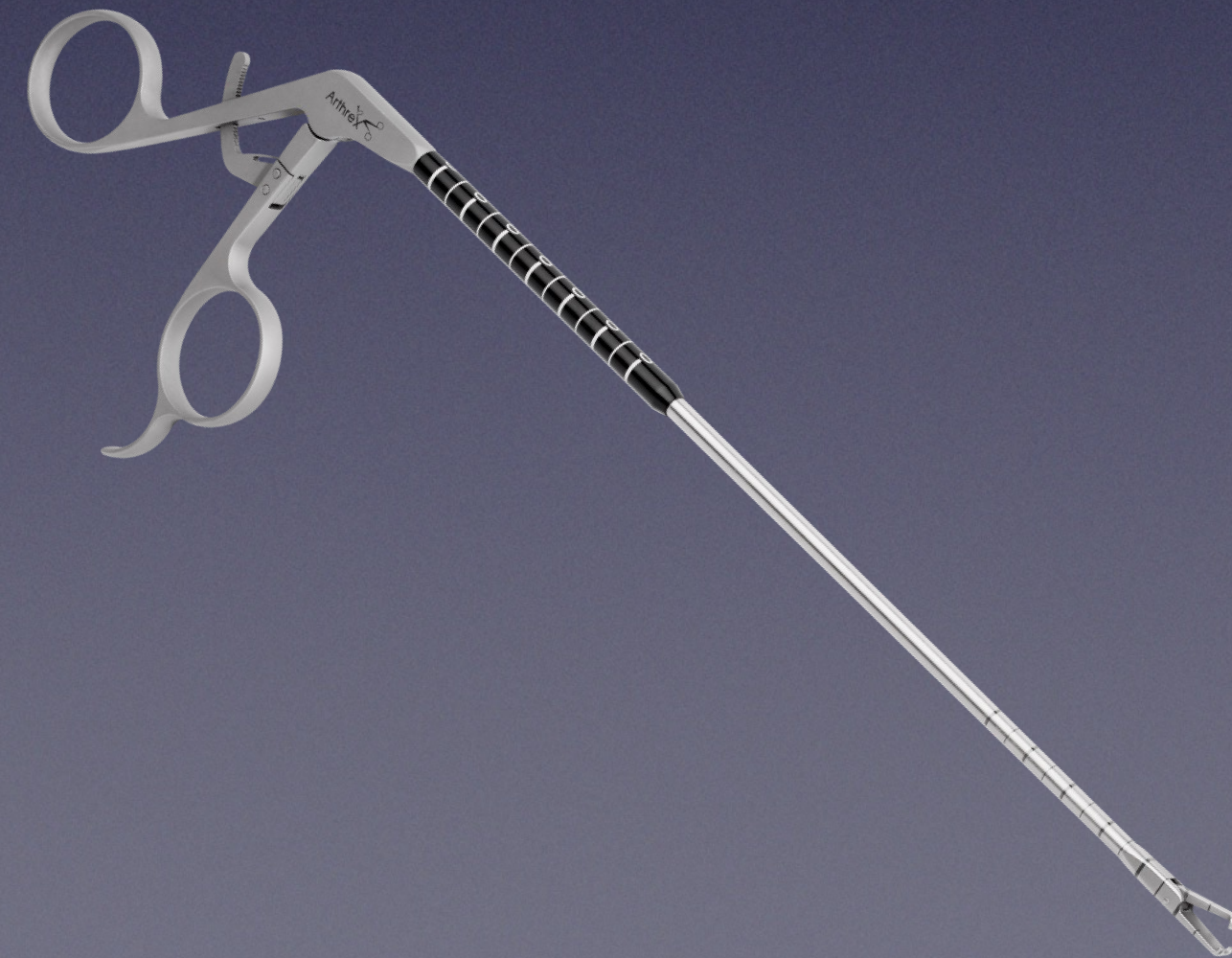
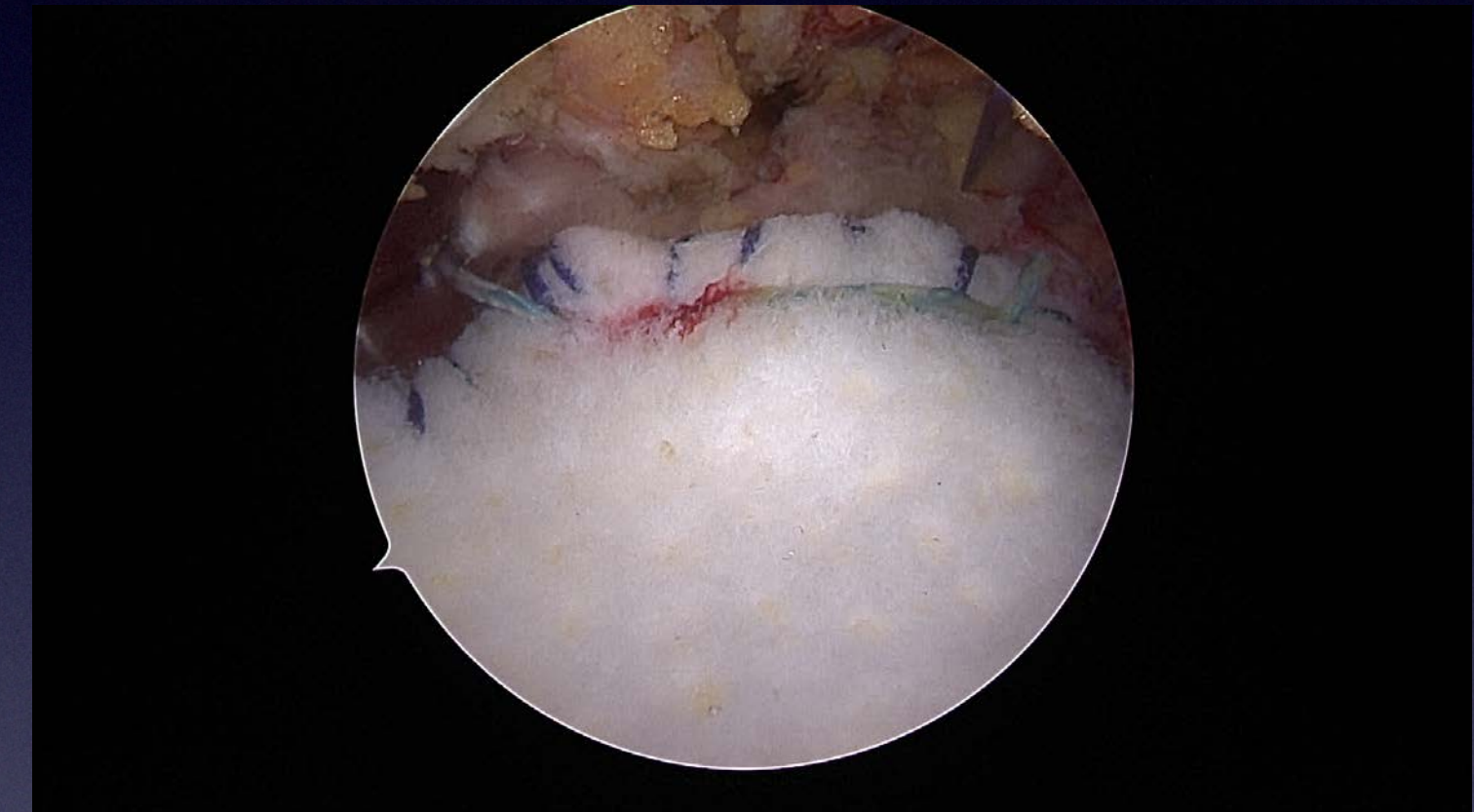
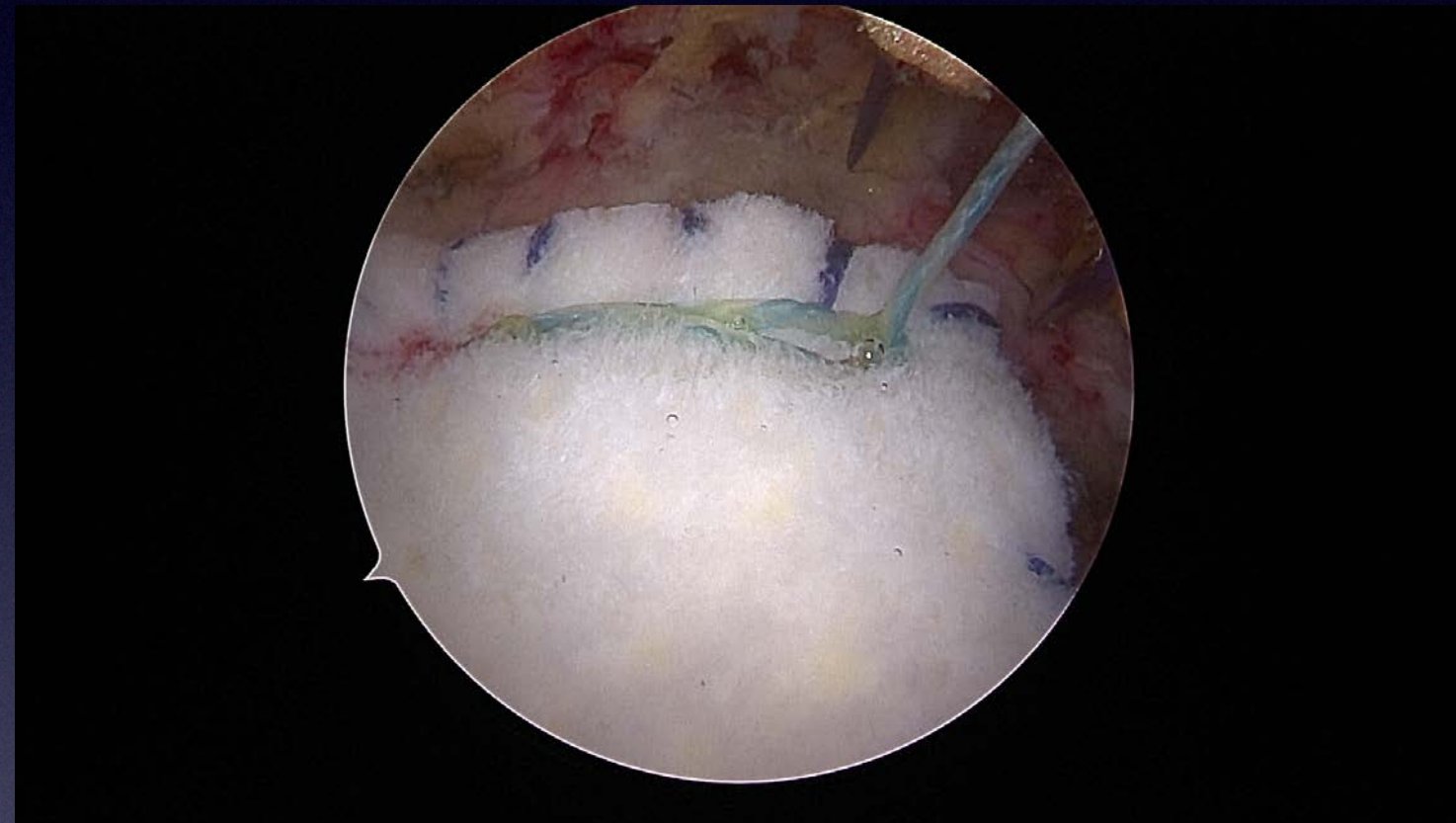
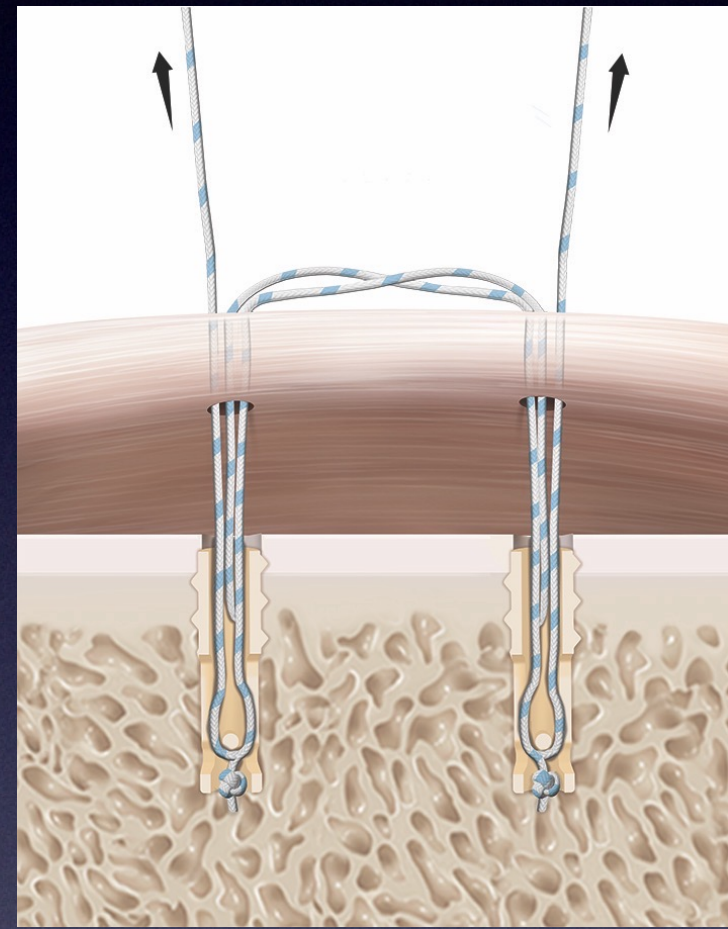
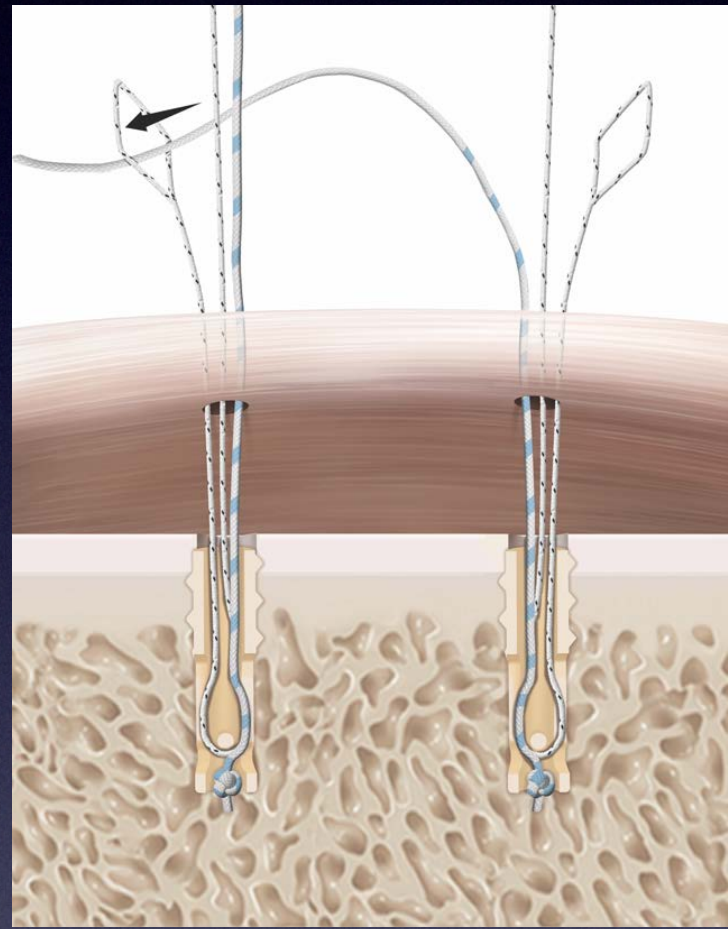
Limitations

The level of evidence of the majority of the included studies was low (3 and 4). According to the Modified Coleman Methodology Score, the quality of most studies was fair (because all of them had a retrospective design), whereas no studies were rated good or excellent and 2 were rated poor.

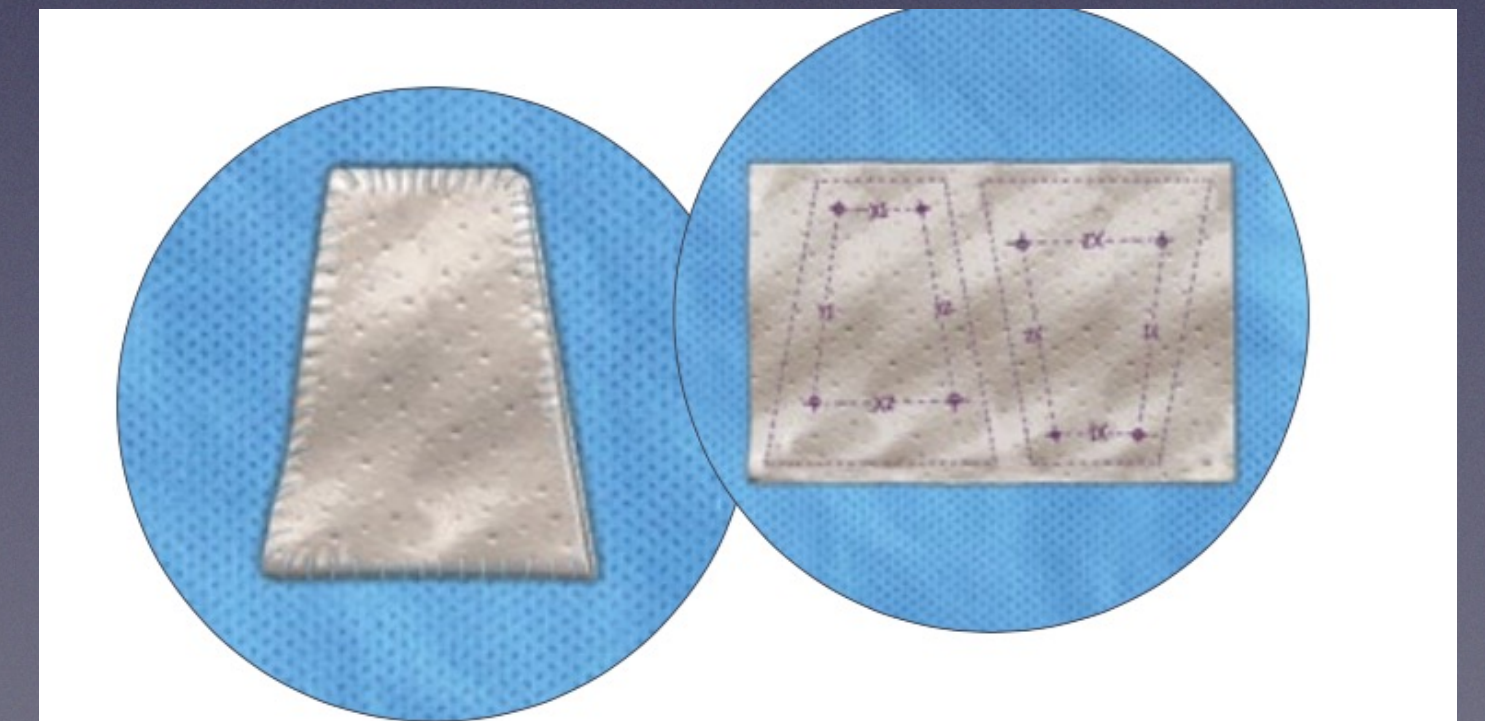
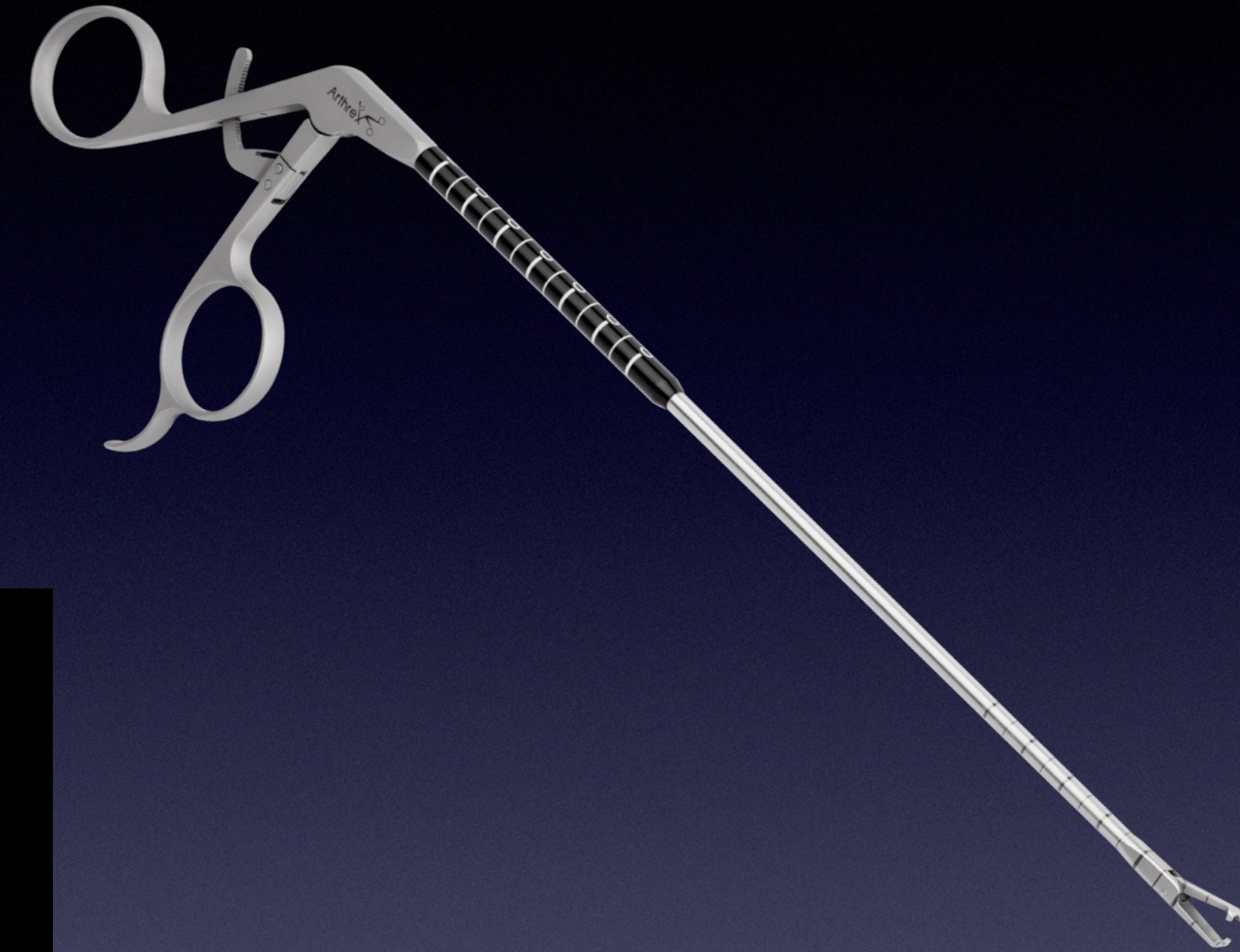
CONCLUSION

SCR showed good to excellent early clinical outcomes, with adequate pain relief and functional improvement. The current evidence suggested that the procedure is an alternative for symptomatic cases of irreparable MRCT; however, there were some notable complications. Long-term follow-up will determine the longevity and ultimate role of this new method in the treatment of irreparable MRCT.

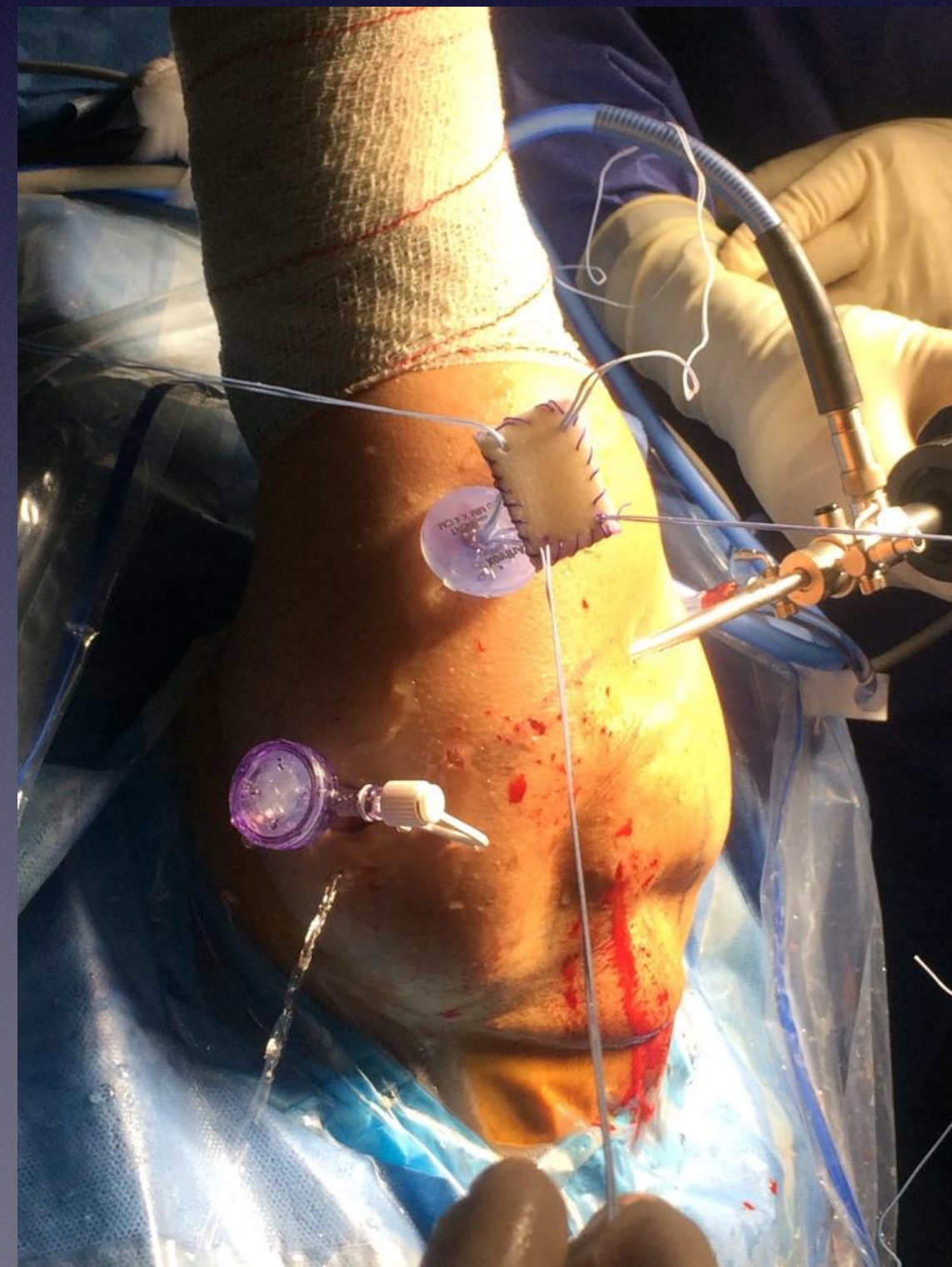
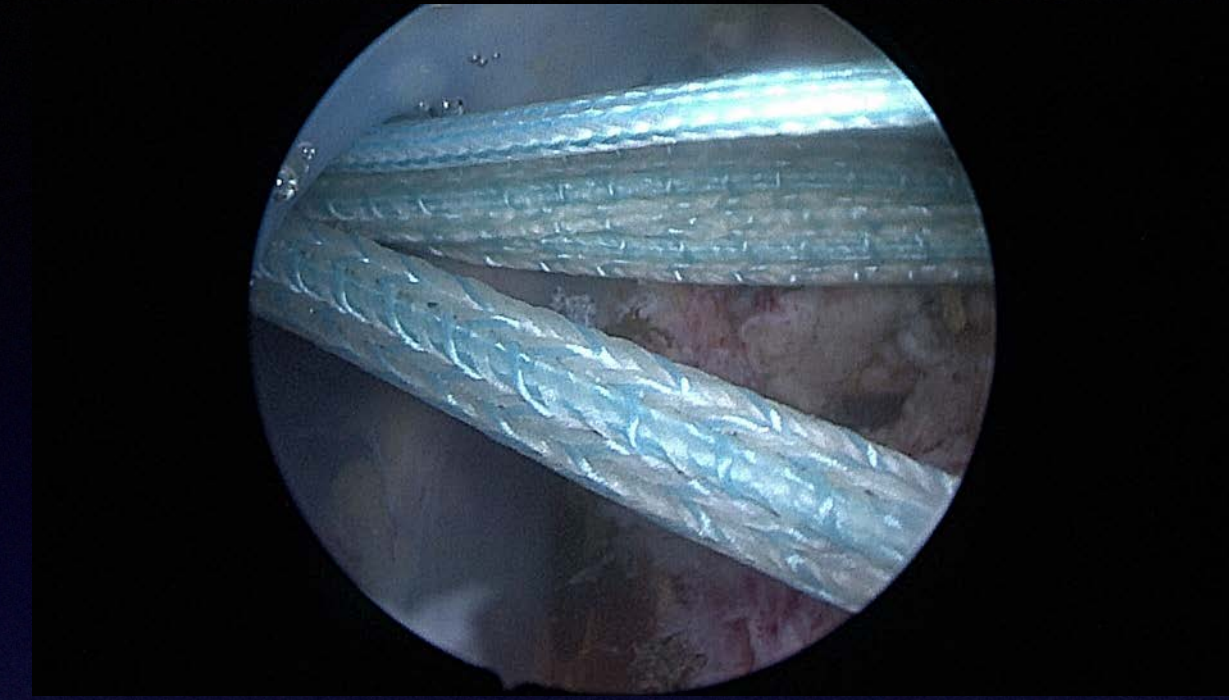
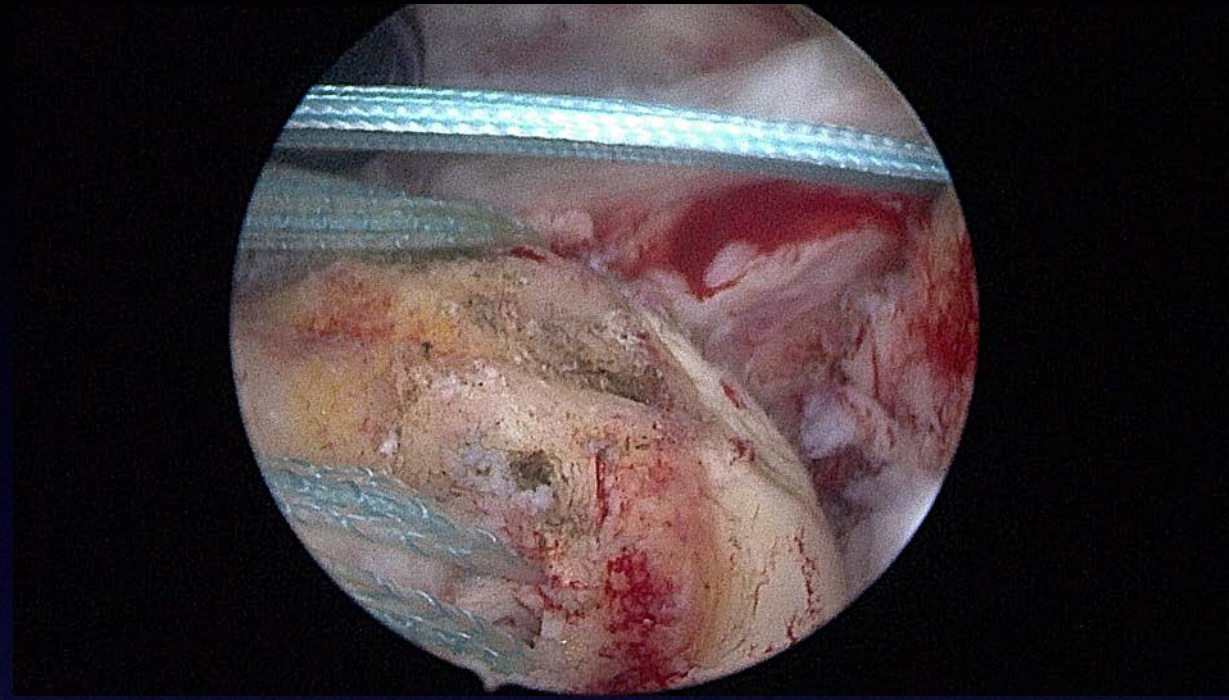
ASPECTOS TECNICOS



¿Por qué fracasa la SCR?



¿Por qué fracasa la SCR?



RM en pacientes con fallo de SCR

74 PACIENTES

11 RM

50%- DESPRENDIMIENTO GLENOIDES

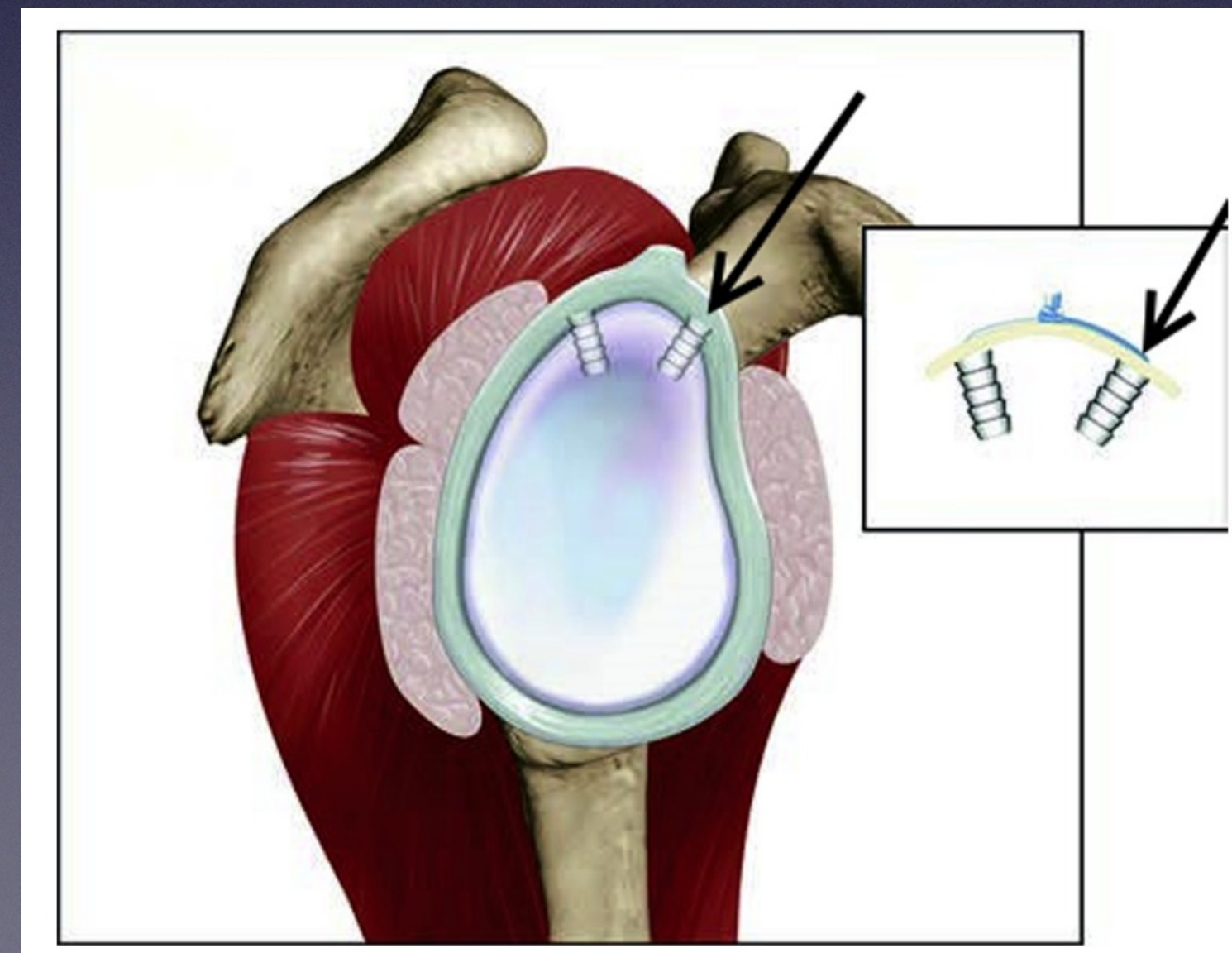
40% ROTURA MEDIAL INJERTO

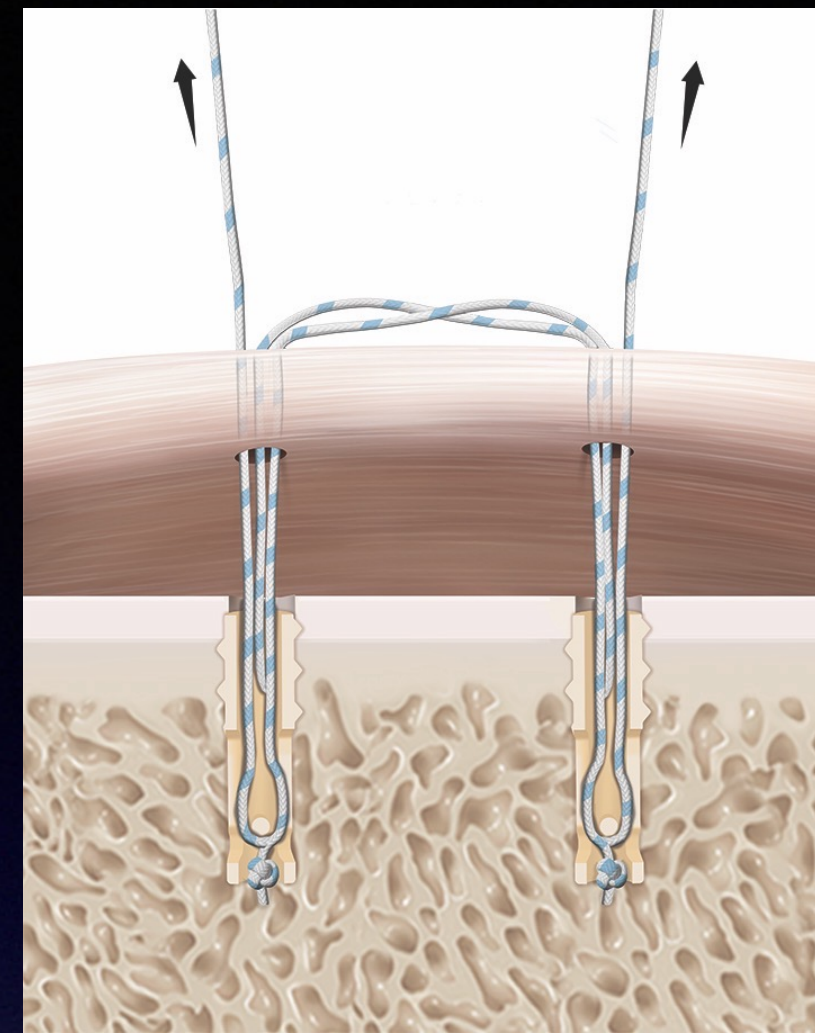
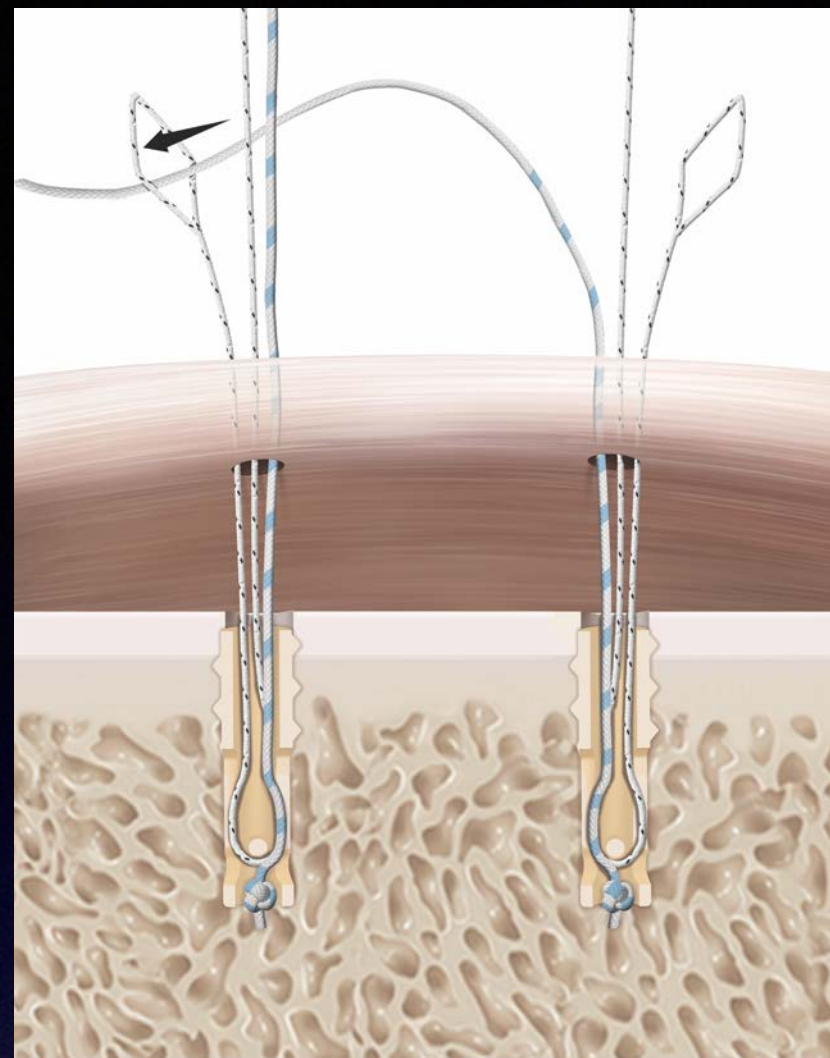
10% ARRANCAMIENTO COMPLETO HUMERAL Y GLENOIDEO

FORTALECER FIJACION GLENOIDEA



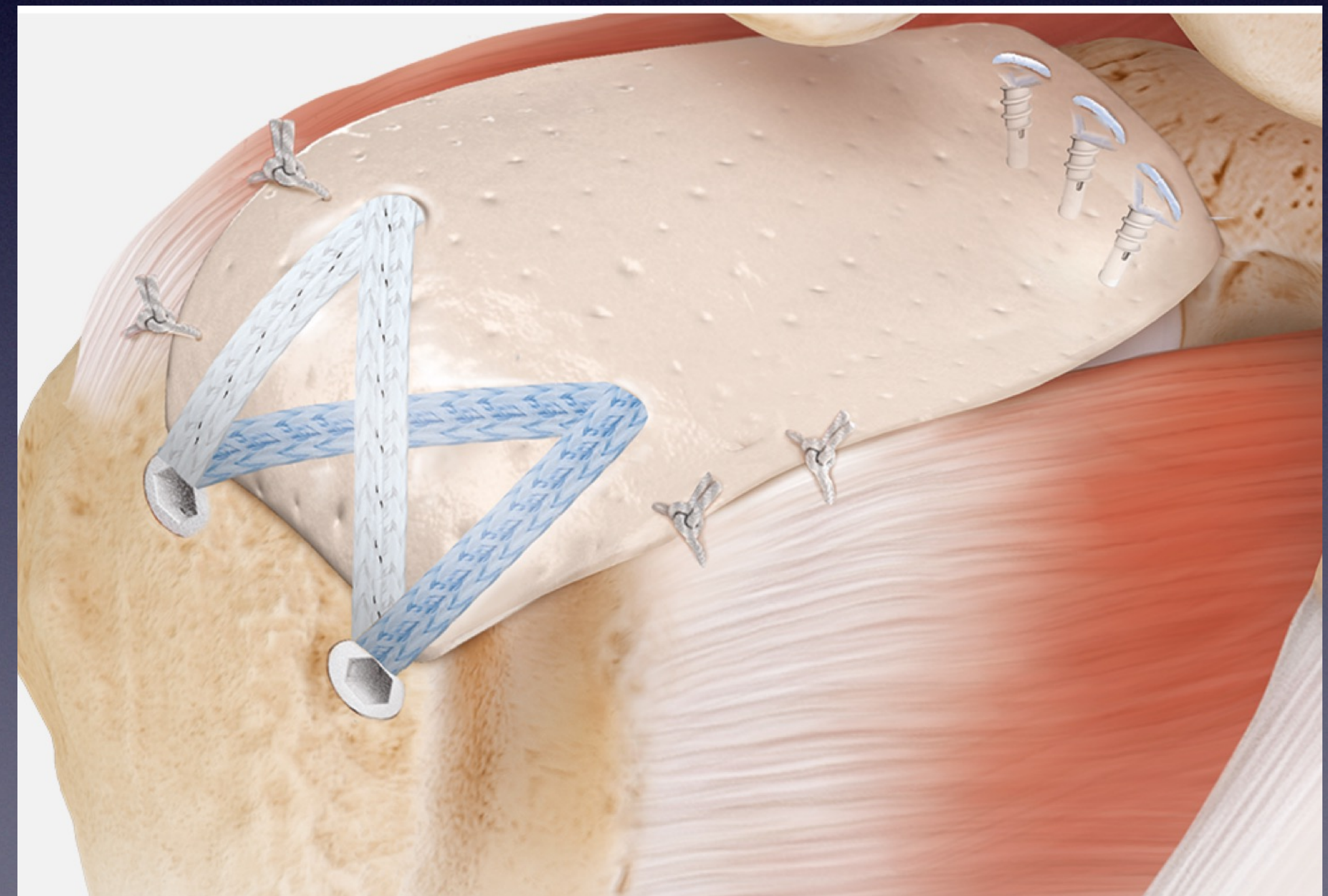
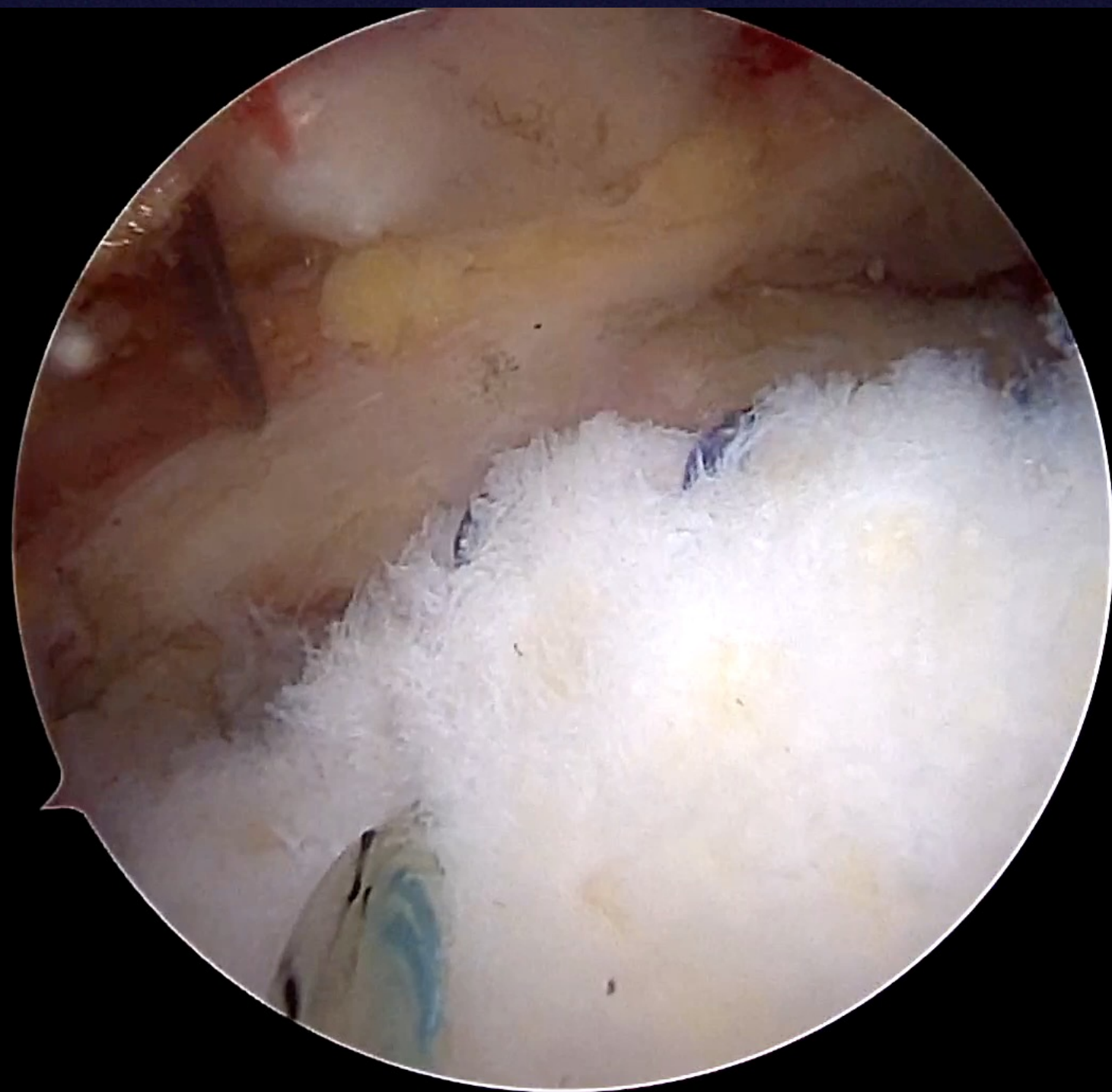
“Magnetic resonance imaging of the failed superior capsular reconstruction”
Christopher P. Emerson, et al.





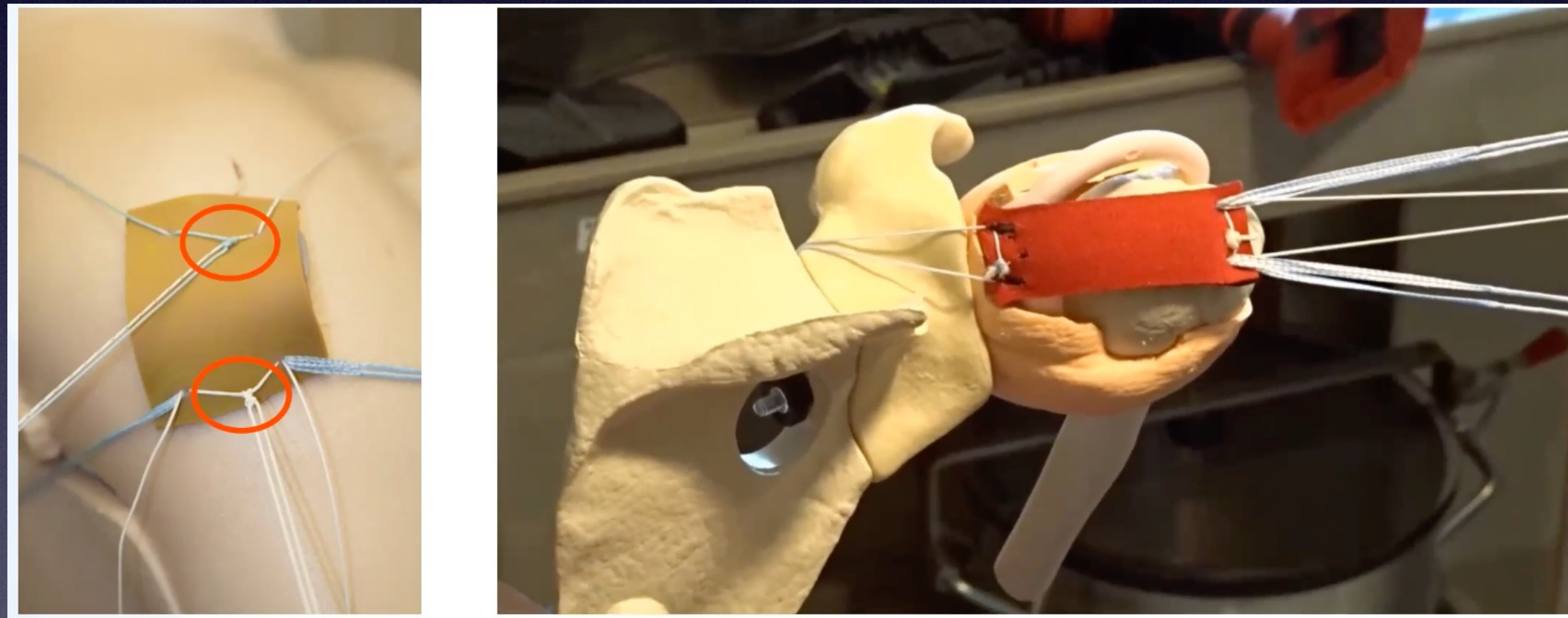
2 Knotless SutureTak

3 anclajes en glena

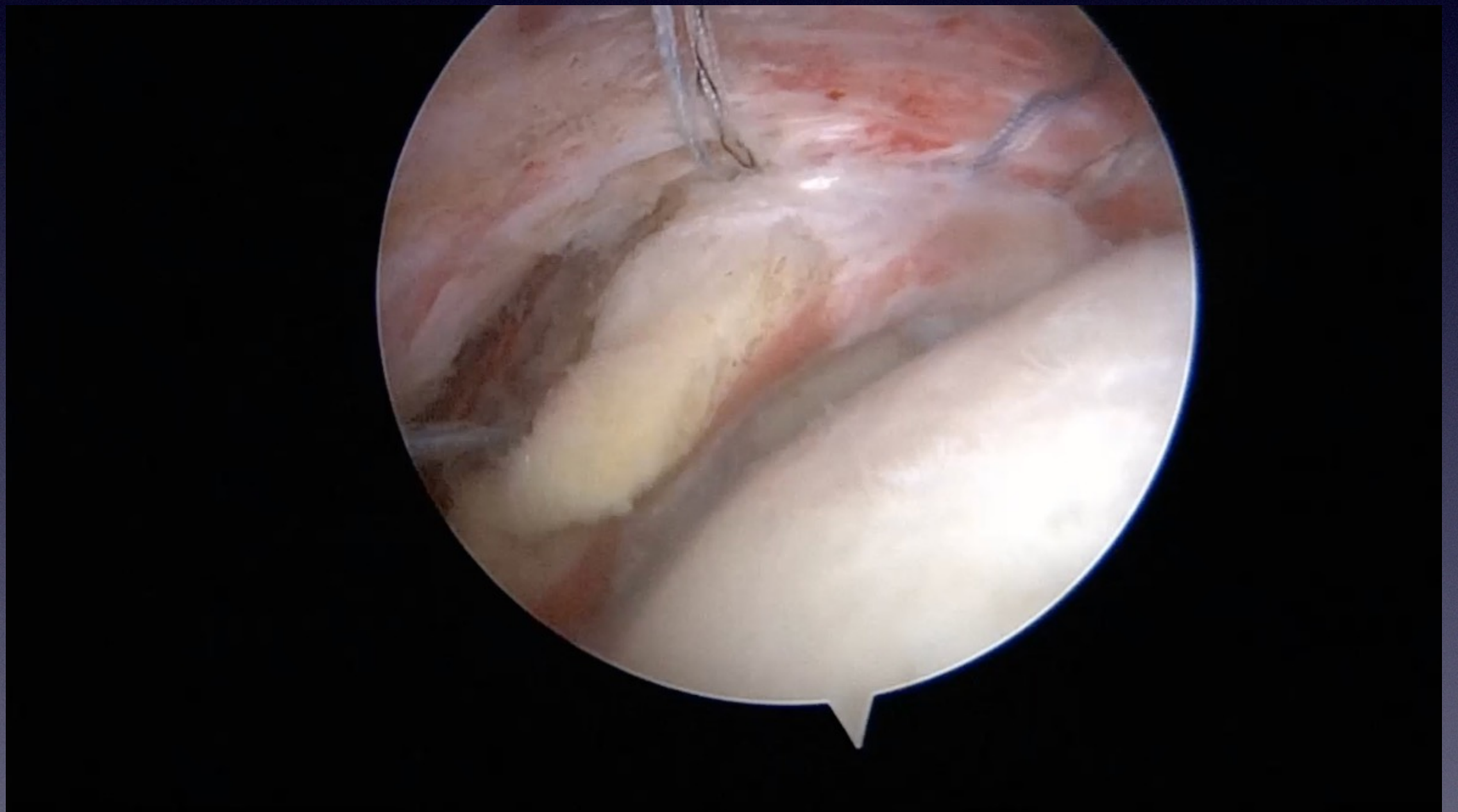


Anclaje de sutura, SutureTak® Knotless de PEEK, sin nudos, Ø 3 mm x 12.7 mm

2 Knotless SutureTak doble polea



3 anclajes en glena interconectados



*Key Tips: 1) Anterior anchor at superior margin of coracoid
2) Place anchors just medial to labrum*

TENSION DEL INJERTO

Editorial Commentary: Shoulder Superior Capsular Reconstruction Graft Tensioning Between 30° and 40° of Glenohumeral Abduction Is Recommended: The Balance Beam of Superior Capsular Reconstruction

Michael J. Foster, M.D., Jared A. Hanson, B.A., and Peter J. Millett, M.D., M.Sc.

Abstract: Massive irreparable rotator cuff tears in young, active patients pose a challenging treatment dilemma. Since the relatively recent development of the superior capsular reconstruction (SCR) procedure, the technique has been increasingly used to stave off reverse total shoulder arthroplasty in this demographic. As a result of continued output of supportive literature, both biomechanically and clinically, SCR has been adopted by surgeons despite some technical aspects of the procedure not being fully elucidated. One notable topic of study is the ideal glenohumeral position in which to determine graft length and therefore graft tension. Tensioning inevitably affects glenohumeral joint kinematics, including superior humeral head translation, subacromial contact pressure, and graft healing potential. Although it is currently known that some degree of glenohumeral abduction is necessary for appropriate graft tensioning, and there are some biomechanical studies from our group and other groups that have looked at this, there is not a clinically supported position in which to measure graft length and therefore set graft tension. Well-designed biomechanical studies will serve as the foundation for what is performed clinically. On the basis of the best available evidence, tensioning the graft between 30° and 40° of glenohumeral abduction is recommended and has yielded encouraging clinical outcomes for SCR in our patients.

See related article on page 1398

Massive irreparable rotator cuff tears remain a challenge to treat, especially in the young, active

Vail, Colorado

The authors report the following potential conflicts of interest or sources of funding: M.J.F. receives a yearly salary from Steadman Philippon Research Institute (SPRI), outside the submitted work. J.A.H. is employed by SPRI, outside the submitted work. SPRI exercises special care to identify any financial interests or relationships related to research conducted here. During the last calendar year, SPRI has received grant funding or in-kind donations from Arthrex, Department of Defense Office of Naval Research, DJO, Major League Baseball, Ossur, Siemens, Smith & Nephew, and XTRE. P.J.M. is a consultant for Arthrex; receives royalties from Arthrex, Springer Publishing, and Medbridge; receives grants from Arthrex; owns stock options in VuMedi; and is part owner of ProofPoint Biologics, outside the submitted work. In addition, his institution receives funding from Arthrex, Smith & Nephew, Siemens, and Ossur and his research activities are supported by SPRI, outside the submitted work. Full ICMJE author disclosure forms are available for this article online, as supplementary material.

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1408

Arthroscopy: The Journal of Arthroscopic and Related Surgery, Vol 38, No 5 (May), 2022: pp 1408-1410

population. Although various treatment options exist, superior capsular reconstruction (SCR) is a viable procedure for irreparable posterosuperior rotator cuff tears, showing improved clinical outcomes in short- and mid-term studies.¹⁻⁴ Although Mihata et al.³ originally described reconstruction of the superior capsule using a fascia lata autograft, the procedure has continued to evolve, with increasing use of acellular human dermal allograft to avoid donor-site morbidity and to reduce surgical time. A number of studies have shown successful clinical outcomes using SCR,^{1,4-6} including our own series by Petri et al.,⁷ Lacheta et al.,⁸ and Ciccotti et al.⁹ Despite good clinical outcomes, questions regarding several technical aspects of the procedure still exist, including the ideal graft tension for optimal clinical outcomes.

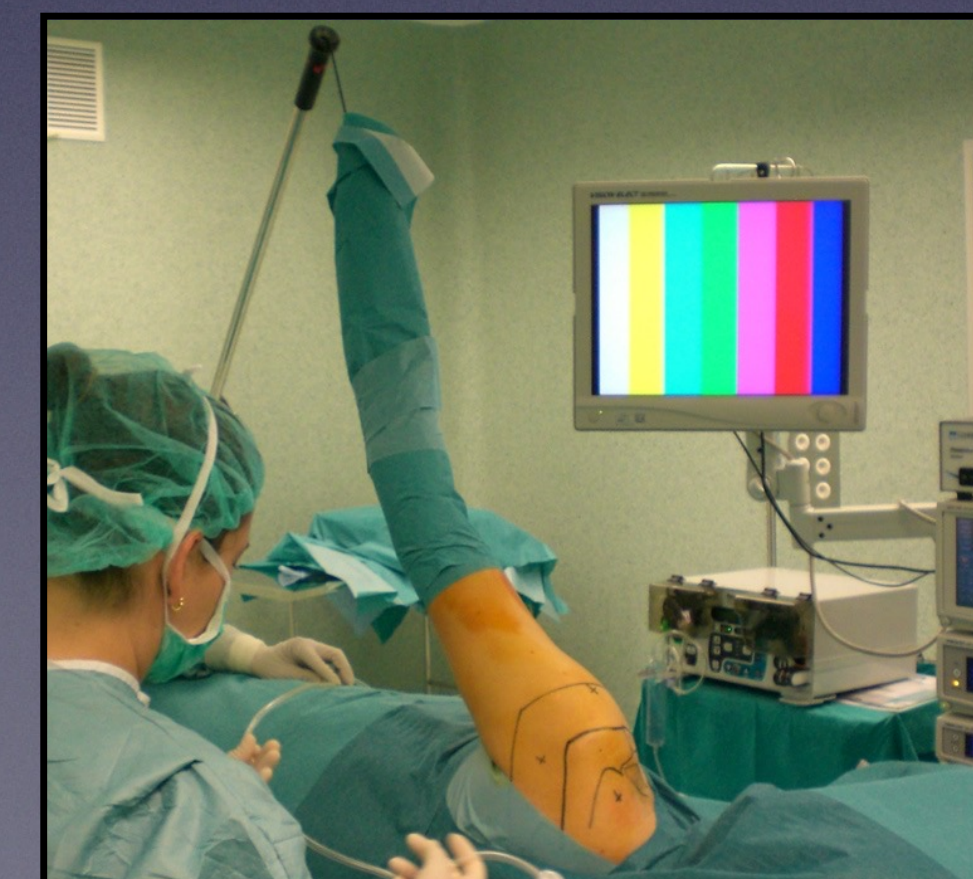
We commend Tibone, Mansfield, Kantor, Giordano, Lin, Itami, McGarry, Adamson, and Lee¹⁰ for reporting on the biomechanical effects of determining graft length for SCR with human dermal allograft at 20° and

A number of studies have shown successful clinical outcomes using SCR,^{1,4-6} including our own series by Petri et al.,⁷ Lacheta et al.,⁸ and Ciccotti et al.⁹ Despite **good clinical outcomes**, questions regarding several technical aspects of the procedure still exist, including the **ideal graft tension for optimal clinical outcomes**.

For most patients, we **tension the graft with the arm position set between 30 and 40 of glenohumeral abduction and furthermore routinely repair the graft to the upper border of the subscapularis and the remaining infraspinatus or teres minor to restore glenohumeral force couples**.

POSICION DEL PACIENTE DECUBITO LATERAL

30° 40° de ABD





Article

Shoulder Positioning during Superior Capsular Reconstruction: Computational Analysis of Graft Integrity and Shoulder Stability

Madalena Antunes ¹, Carlos Quental ^{1,*}, João Folgado ¹, Clara de Campos Azevedo ^{2,3,4} and Ana Catarina Ângelo ⁴

- ¹ IDMEC, Instituto Superior Técnico, Universidade de Lisboa, Av. Rovisco Pais, 1049-001 Lisboa, Portugal; madalena.antunes@tecnico.ulisboa.pt (M.A.); jfolgado@tecnico.ulisboa.pt (J.F.)
- ² Life and Health Sciences Research Institute (ICVS), School of Medicine, University of Minho, Campus de Gualtar, 4710-057 Braga, Portugal; claracamposazevedo@gmail.com
- ³ ICVS/3B's-PT Government Associate Laboratory, 4805-017 Braga/Guimarães, Portugal
- ⁴ Hospital dos SAMS de Lisboa, 1849-017 Lisboa, Portugal; ana.cat.angelo@gmail.com
- * Correspondence: carlos.quental@tecnico.ulisboa.pt

Simple Summary: In arthroscopic superior capsular reconstruction (ASCR) in irreparable rotator cuff tears (IRCTs), a graft is positioned and fixed between the superior rim of the glenoid and the humeral supraspinatus footprint. The fixation of the graft aims to restore the stability and improve the kinematics of the shoulder. The shoulder position during fixation of the graft may be a key factor impacting the outcome of ASCR; however, biomechanical evidence is lacking, as most studies addressing ASCR have been conducted in cadavers. In this study, graft strain and glenohumeral joint reaction force, estimated using a 3-D musculoskeletal model of the upper limb, were used to evaluate graft integrity and shoulder stability, respectively. The results suggest that ASCR significantly improved shoulder stability compared to the preoperative condition; however, the shoulder positions of fixation associated with the greatest improvements were also associated with the highest risk of compromising the integrity of the graft due to high strains. This study provides new and important information regarding the role of shoulder positioning during fixation of the graft.

Abstract: The shoulder position during fixation of the graft may be a key factor impacting the outcome of arthroscopic superior capsular reconstruction (ASCR) in irreparable rotator cuff tears (IRCTs). However, biomechanical evidence regarding this effect is lacking. The aim of this study was to evaluate the influence of the shoulder position during fixation of the graft on shoulder stability and graft tear risk in ASCR. A 3-D musculoskeletal model of the upper limb was modified to account for the fixation of the graft in ASCR, assuming a full-thickness tear of the supraspinatus tendon. The concomitant tenotomy of the long head of the biceps (LHB) tendon was also studied. The biomechanical parameters evaluated included the strain of the graft and the glenohumeral joint reaction force (GH JRF), which were used to evaluate graft integrity and shoulder stability, respectively. Fixation of the graft considering abduction angles greater than 15° resulted in a high risk for graft tearing when the arm was adducted to the side of the trunk. For abduction angles below 15°, the mean shoulder stability improved significantly, ranging between 6% and 20% ($p < 0.001$), compared with that in the preoperative condition. The concomitant tenotomy of the LHB tendon resulted in loss of stability when compared to ASCR with an intact LHB tendon. The position of the shoulder during fixation of the graft has a significant effect on shoulder stability and graft tear risk after ASCR in IRCTs. This study provides new and important information regarding the role of shoulder positioning during fixation of the graft.

Keywords: rotator cuff tear; arthroscopic superior capsular reconstruction; fascia lata graft; shoulder stability; musculoskeletal model



Citation: Antunes, M.; Quental, C.; Folgado, J.; de Campos Azevedo, C.; Ângelo, A.C. Shoulder Positioning during Superior Capsular Reconstruction: Computational Analysis of Graft Integrity and Shoulder Stability. *Biology* **2021**, *10*, 1263. <https://doi.org/10.3390/biology10121263>

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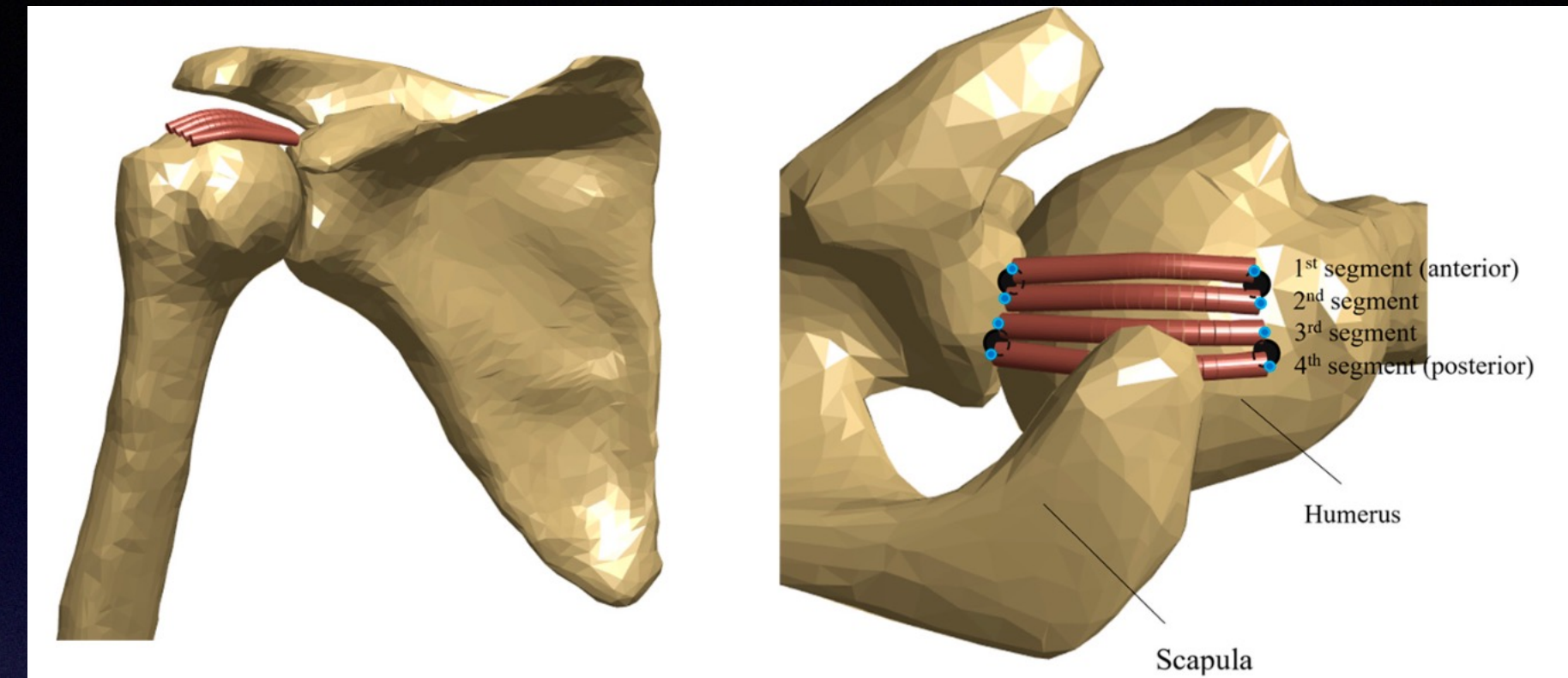
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La fijación del injerto con ángulos superiores a **15° de ABD** se asocia a **ALTO RIESGO DE ROTURA** con el brazo en ADD

La **tenotomía** de la **PLB** concomitante produce **INESTABILIDAD** en comparación SCR y PLB intactos

TENSION

La Posición del brazo es Crítica

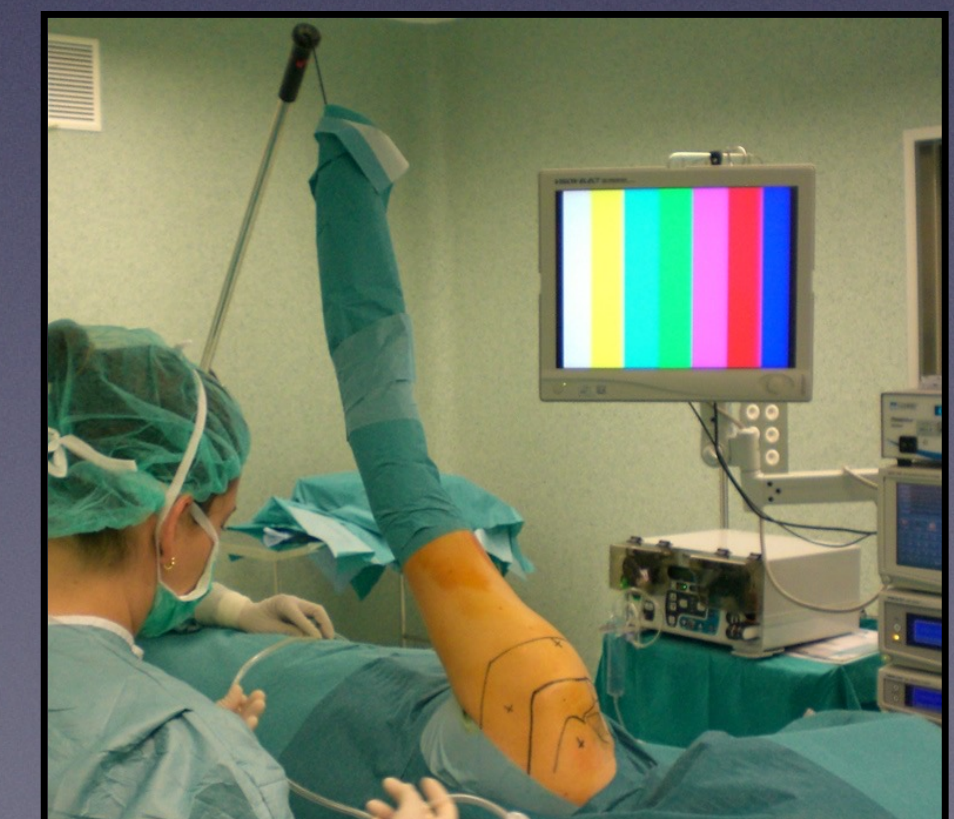
Silla de playa

Permite posicionar el brazo donde queramos
Posición neutra (Hirahara)



Decúbito lateral

Tiende a colocar el brazo con demasiada ABD
y rotación interna



AUMENTO DE DISTANCIA DE LAS SUTURAS AL BORDE DEL INJERTO

Original Article

Increased Bite Distance From the Edge Lowers Risk of Pullout of Simple Sutures from Acellular Dermal Allograft

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Purpose: To investigate whether pullout strength in the acellular dermal allograft matrix (ADM) used for superior capsule reconstruction depends on the distance from the edge of the graft. **Methods:** ADM used for superior capsule reconstruction was obtained and cut into 30 squares. Two sutures were placed through the center of each graft by using a loaded Keith needle and forming a simple stitch. The grafts were divided into 3 groups of 10 grafts with a distance of 5 mm, 10 mm or 15 mm from the closest edge of the graft, respectively. The grafts were then preloaded to 5 N and pulled to failure at a rate of 12 mm/s on an MTS 858 MiniBionix servohydraulic mechanical test frame. The load to failure was recorded as well as the stiffness of each graft. **Results:** The mean load to failure was 34.5 N (SD 7.89) for the 5 mm grafts, 31.7 N (SD 5.99) for the 10 mm grafts, and 66.2 N (SD 18.4) for the 15 mm grafts. There was a significant difference (< 0.0001) between the large grafts (15 mm) and the 2 smaller grafts (10 mm, 5 mm). There was no significant difference in stiffness between the groups of graft ($P 0.40$). **Conclusion:** Placing the suture at least 15 mm from the edge of the graft increases the graft's ultimate yield strength to suture pullout. **Clinical Relevance:** The depths of the suture in ADM could improve pullout strength for constructs of superior capsular reconstructions.

Massive rotator cuff tears are difficult to treat because of high failure rates, even after surgical management.¹ Tendon transfers and direct repairs carry a 52% recurrence rate, and reverse total shoulder arthroplasty studies have shown satisfactory results in the older population, but subjects were not matched to younger patients.²

Superior capsule reconstruction (SCR) has become a newer treatment option for massive rotator cuff tears. Originally described using a fascia lata autograft, surgeons have now proposed dermal allograft matrix (ADM) for its reliable elongation properties, faster surgical times and elimination of donor-site morbidity.³

Major complications have been cited as being tears or pullouts of grafts, which the literature has shown can range from a 3.4% to a 55% tear rate with allograft reconstructions.⁴⁻⁶ There have been biomechanical studies that investigated the pullout strength in relation to the graft thickness as well as glenoid suture configuration.^{7,8} However, little is known about the distance from the edge of the graft and the placement of the suture. With more than 29 different surgical techniques for SCR, we limited as many variables, such as suture configuration and location, as possible and tested the inherent properties of the ADM.⁹

The purpose of this study was to investigate whether pullout strength in the ADM used for superior capsule reconstruction depended on the distance from the edge of the graft. Our hypothesis was that the deeper the suture was placed into the graft (5 mm, 10 mm or 15 mm), the stronger the ultimate yield of the graft to suture pullout would be, based on previous biomechanical studies with suture pullout in fascial planes.¹⁰

Methods

Graft Preparation

Four ADM grafts were obtained that were 40 mm x 70 mm and had a graft thickness of 1.4 mm. The grafts

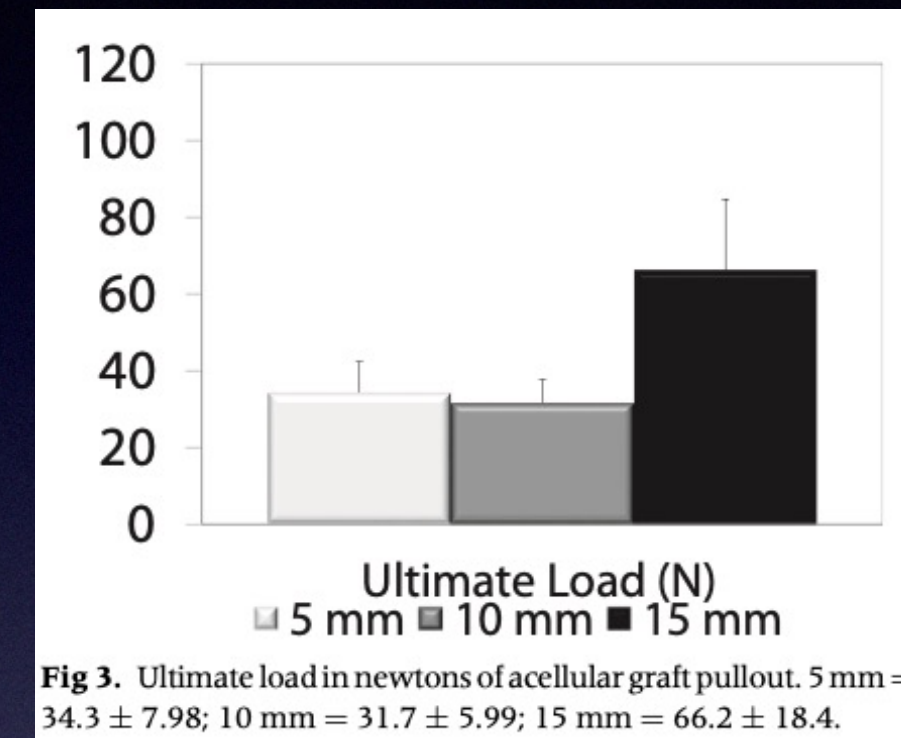
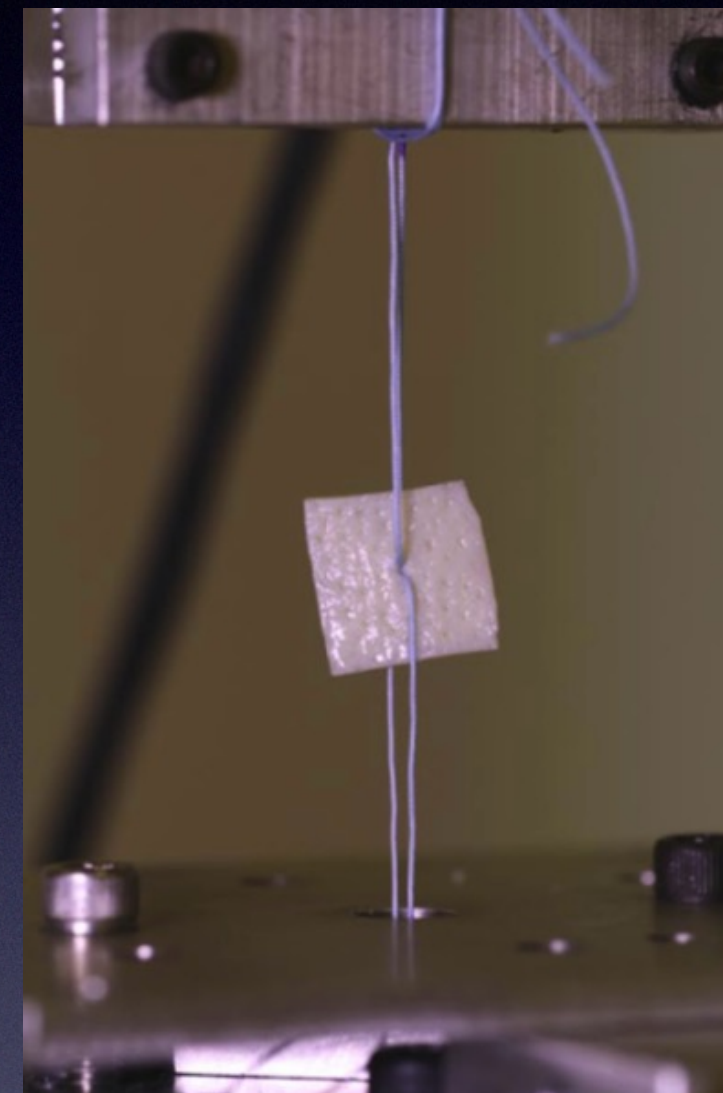
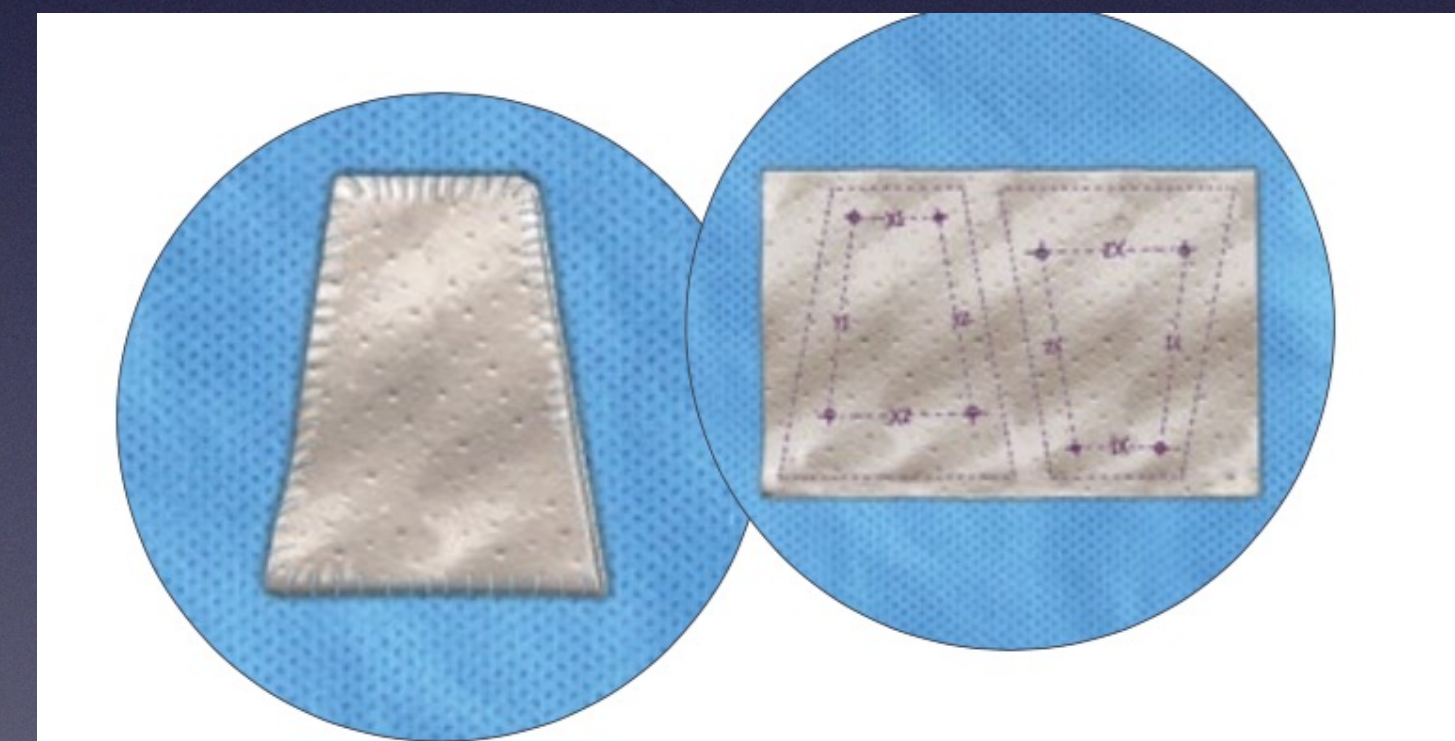
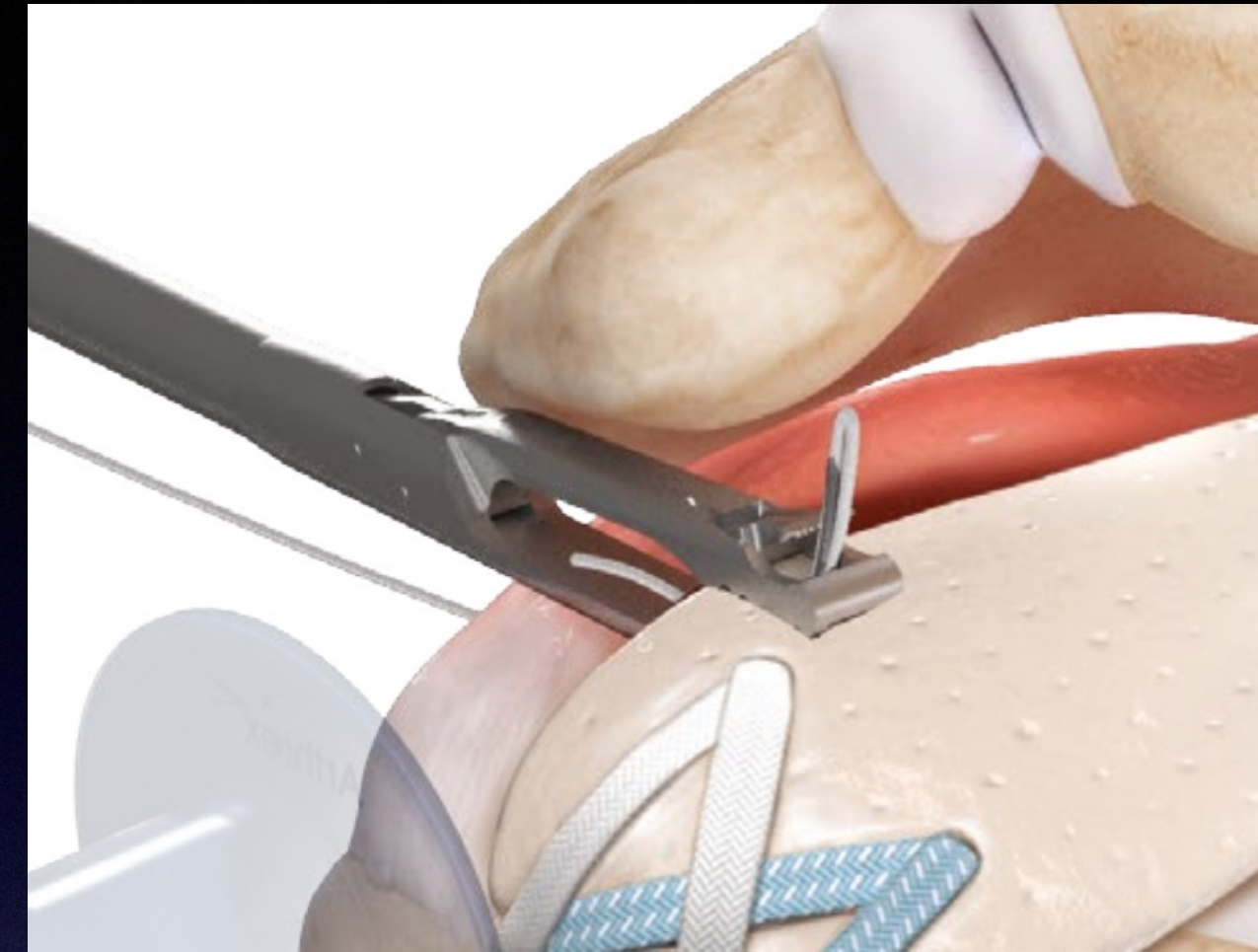


Fig 3. Ultimate load in newtons of acellular graft pullout. 5 mm = 34.3 ± 7.98; 10 mm = 31.7 ± 5.99; 15 mm = 66.2 ± 18.4.



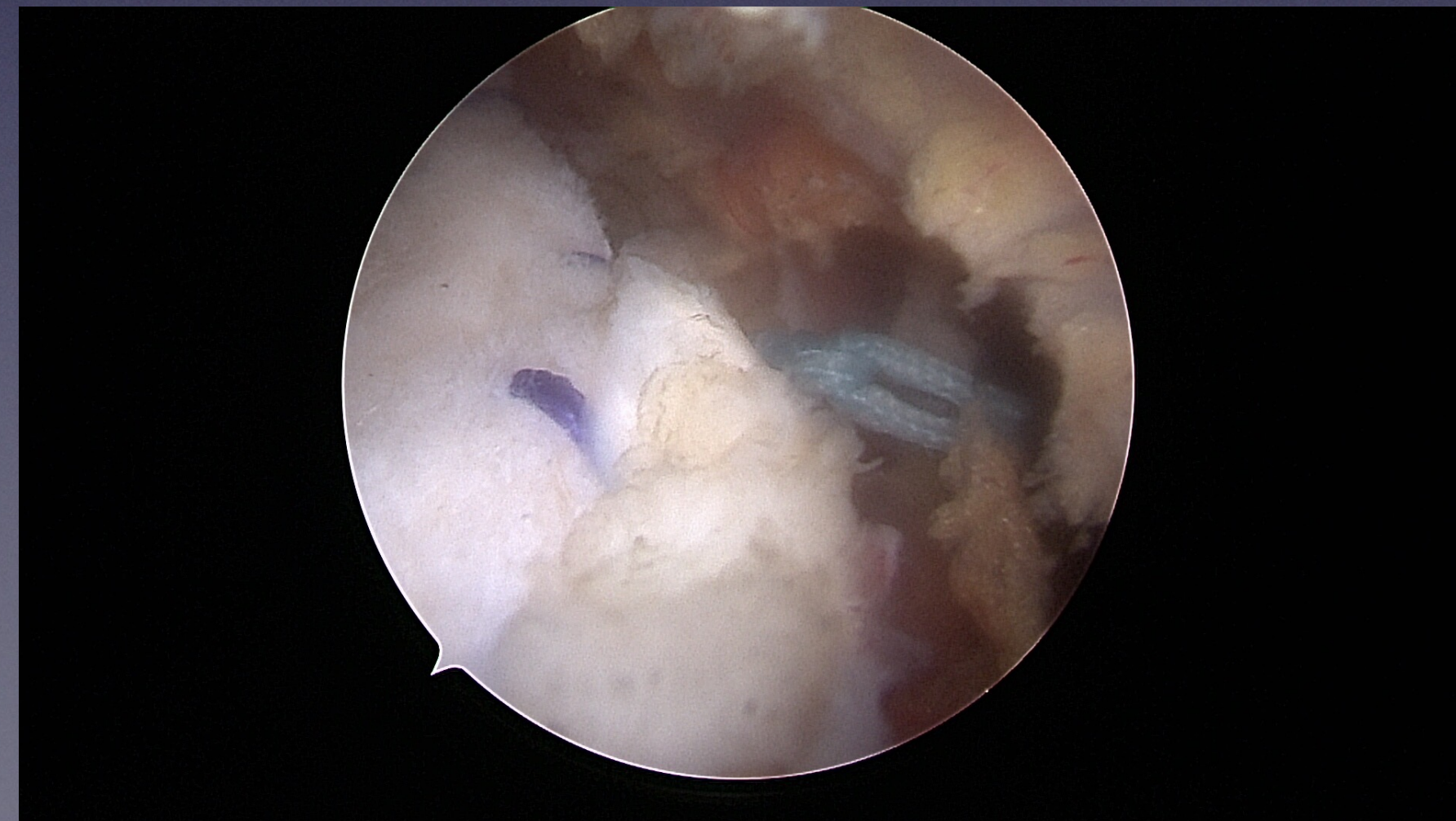
Colocar la sutura al menos a **15 mm del borde del injerto** aumenta el limite elástico máximo para arrancarla



Margin Convergence

Pass 2-3 margin convergence stitches to the remaining infraspinatus with a lasso or Scorpion suture passer.

Careful attention should be paid to not overtighten the anterior aspect to help avoid shoulder contracture after surgery. Over-constraining the anterior graft may result in decreased rotational motion and increased risk of graft or tissue failure. Anterior graft attachment may not be necessary.¹



FACTORES ASOCIADOS AL PACIENTE



INFILTRACION GRASA

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Superior capsule reconstruction using dermal allograft: early outcomes and survival

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Background: Superior capsule reconstruction (SCR) has shown promising outcomes in its initial description, but lacks additional reports analyzing outcomes. This study analyzes early outcomes of SCRs in patients with massive irreparable rotator cuff tears.

Methods: A retrospective analysis of all SCRs at our institution from January 1, 2015, to August 31, 2017, was performed with a minimum 6-months follow-up. A total of 34 patients were included with a mean age of 60 years. SCR was performed by 1 of 6 fellowship trained surgeons.

Results: At an average follow-up of 12 months, 22 patients were identified as failures after modified Neer classification. Furthermore, 8 of these patients have undergone a reoperation, whereas an additional 14 patients were considered clinical failures experiencing continued pain and a lack of shoulder function. Of note, 2 of the 3 patients with a subscapularis tear had a failure. In addition, revision cases, female gender, increased fatty infiltration in the infraspinatus and low surgeon volume were associated with a higher rate of failure. There was no significant improvement in range of motion or functional scores.

Conclusion: SCR performed for large-to-massive irreparable rotator cuff tears has a high rate of persistent pain and poor function leading to clinical failure in 65% of patients. Risk factors predicting clinical failure included revision cases, female gender, increased Goutallier fatty infiltration of the infraspinatus, and low surgeon volume ($n \leq 10$).

Level of evidence: Level IV; Case Series; Treatment Study

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Keywords: Superior capsule reconstruction; massive rotator cuff tear; irreparable rotator cuff tear; revision surgery; failure

Each author certifies that his or her institution approved the human protocol for this investigation and that all investigations were conducted in conformity with ethical principles of research.

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Chronic massive irreparable rotator cuff tears represent a challenge and the optimal treatment strategy remains controversial.^{3,13,14,17,33,39,50} Although complete repair of the rotator cuff provides improved pain, range of motion, and functional outcomes,^{23,24} large tears with advanced fatty infiltration are either considered irreparable or have an unacceptably higher rate of retear when repair is

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The Goutallier classification breakdown for those who have **preoperative** magnetic resonance imaging (MRIs) (n 1/4 31) is summarized in Table II. Overall, increasing grades of fatty infiltration in the infraspinatus were associated with an increased rate of failure ($P < .04$) and reoperation ($P < .02$). Furthermore, **grade 2 of higher fatty infiltration in the infraspinatus was associated with an increased rate of failure** ($P < .01$), as 16 of the 19 patients with failures who had preoperative MRIs had grade 2 or higher in the infraspinatus compared with 3 of 12 who did not fail.



Table II Preoperative imaging classification

Goutallier stage (n = 31)	Supraspinatus, %	Infraspinatus, %	Teres minor, %	Hamada grading (n = 28)	Percentage (%)
0	6.3	3.1	0.0	1	71.4
1	9.4	28.1	90.6	2	28.6
2	9.4	46.9	9.4	3	0.0
3	31.3	18.8	0.0	4	0.0
4	43.8	3.1	0.0		

FACTORES ASOCIADOS CON FRACASO DE SCR

ALTO GRADO DE FRACASO

1-Mujeres

2-Pacientes con rotura subescapular

FRACASO CLINICO

3-Índice de masa corporal elevado

4-Poca flexión anterior preoperatoria

5-Distancia acromio-humeral preoperatoria disminuida

DEGENERACION GRASA INFRAESPINOSO

Patient Factors Associated With Clinical Failure Following Arthroscopic Superior Capsular Reconstruction

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Purpose: To identify demographic, clinical, and radiographic factors associated with failure after superior capsular reconstruction (SCR). **Methods:** Prospectively collected data were analyzed from patients who underwent SCR using a decellularized dermal allograft for an irreparable rotator cuff tear. Demographic characteristics, radiographic findings, concomitant procedures, and patient-reported outcomes (PROs) were recorded. Failure was defined by ≥ 1 of the following criteria: (1) conversion to reverse total shoulder arthroplasty (RTSA), (2) a decrease in 1-year postoperative shoulder-specific PROs compared with preoperative scores, or (3) patient reports at final follow-up that the shoulder was in a worse condition than before surgery. Preoperative variables were compared between patients meeting the criteria for clinical failure and those who did not. **Results:** Fifty-four patients (mean age 56.3 ± 5.8 years, range 45 to 70) who underwent SCR, with minimum 1-year follow-up, were included in the analysis. Mean follow-up after surgery was 24 months (range 12 to 53). Eleven patients (20.4%) met criteria for clinical failure. Of the 11, 8 reported decreased American Shoulder and Elbow Surgeons (ASES) or Constant scores or indicated that the operative shoulder was in a worse condition than before surgery. Three patients underwent RTSA in the 6 to 12 months after SCR. Female sex and the presence of a subscapularis tear were associated with failure ($P = .023$ and $P = .029$, respectively). A trend toward greater body mass index (BMI), lower preoperative forward flexion, and lower preoperative acromiohumeral distance (AHD) was found in patients with clinical failure ($P = .075$, $P = .088$, and $P = .081$, respectively). No other variable included in the analysis was significantly associated with failure. **Conclusion:** The proportions of female patients and those with subscapularis tear were greater among patients with clinical failure after SCR. Greater BMI, lower preoperative forward flexion, and lower preoperative AHD trended toward association with clinical failure of SCR. **Level of Evidence:** 4, case series.

See commentary on page 468

Management of symptomatic patients with an irreparable rotator cuff tear who have failed conservative management remains challenging.¹ Many current and historical procedures have been used to address rotator cuff deficiency in the setting of minimal arthritis, including partial repair,² debridement,^{3,4} subacromial decompression,^{5,6} tuberopectasty,⁷

reversed subacromial decompression,⁸ muscle and tendon transpositions or transfers,⁹⁻¹¹ graft augmentation,¹⁰ subacromial spacers,¹¹ and reverse total shoulder arthroplasty (RTSA).¹² However, to date, no procedure has provided optimal and reliable outcomes in terms of pain relief and restoration of function.¹⁻¹³

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CONCLUSIONES

¿Qué debemos tener en cuenta para que no fracase la SCR?

1º Elección adecuada del paciente:

- Edad no avanzada
- No atrofia grasa del infraespinoso. Goutallier I y II
- HAMADA <2

Hamada Classification
for Massive RC Tears

Grade	AH Space	GH Jt	LHB
1	> 6 mm	Normal	Intact
2	< 5 mm	Normal	Tear
3	Acetabulization	Normal	Tear
4	Acetabulization	Narrowed	Tear
4A	No Acetabulization	Narrowed	Tear
4B	Acetabulization	Narrowed	Tear
5	Acetabulization	Humeral collapse	Tear

2º Técnica adecuada:

- Espesor del injerto (>3 mm)
- Tensión del injerto según **posición operatoria**
- Distancia de sutura a borde del injerto de >1.5mm
- Puntos side-to-side a infraespinoso
- Importancia de fortalecer fijación glenoidea
- Preservar la PLB

CONCLUSIONES

*En cualquier caso, se observa **mejoría clínica del dolor y funcional** en la mayoría de los pacientes independientemente del fallo del injerto*