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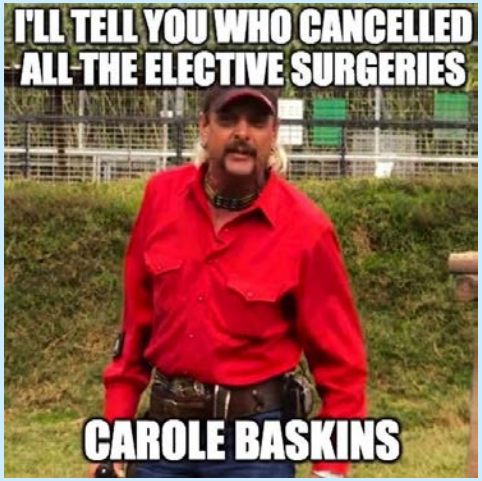


Rotator cuff repair rehabilitation

The case for delayed rehabilitation

Brian Jennings, PT, DPT

WHY DO WE NEED THIS CONVERSATION?

- Too many re-tears
- Healing rates support delayed rehab
- Delayed recovery of motion does not seem to affect functional outcome
- Evidence supports delayed rehabilitation to reduce re-tears

TOO MANY RE-TEARS

- Rates of re-tears
  - Multiple studies report variable ***anatomic*** re-tear rates of 20% to 90%[1,2,3,4,5]
  - Risk factors
    - Age
    - Size of tear
    - Health factors/tissue quality (e.g. diabetes, smoking)
    - Acute tear vs. chronic
    - Chosen surgical technique
    - Rehabilitation progression?

HEALING RATE OF REPAIR

- After initial cell proliferation, primarily Type III collagen fibers form in first 2-3 weeks
- Gradual transition to Type I fibers until mature scar is formed (modeling phase)
- Remodeling, repaired tissue does not reach maximal tensile strength until 12-16 weeks post-surgery
- Mineralized fibrocartilage (normalized bone-tendon interface transition) does not occur until remodeling phase is completed (12-16 weeks)[6,7,8]
- 7/9 failures (out of 22 total patients) in one study occurred in the first 3 months post-surgery[9]

POST-OPERATIVE STIFFNESS DOES NOT SEEM TO AFFECT LONG-TERM OUTCOME

- It does not seem to occur that frequently:
  - Retrospective review of 19,229 RCR patients: only 232 ***(1.2%)*** required lysis of adhesions (LOA) or MUA within 9 months out of surgery[10]
  - Retrospective review of 489 RCR patients: 24 ***(4.9%)*** developed post-op stiffness that led to dissatisfaction with outcome after RCR (LOA performed 4-19 months after initial RCR)[10]
  - Identified risk factors in these studies: Workers compensation, less than 50 y.o., coexisting calcific tendonitis, PASTA lesions, concomitant adhesive capsulitis, concomitant labral repair, type I DM, hypothyroidism, SLE, female gender[10,11]

STIFFNESS AND OUTCOMES

- ***J Bone Joint Surg Am. 2016 Nov 16;98(22):1879-1889.***
  - The Relationship Between Shoulder Stiffness and Rotator Cuff Healing: A Study of 1,533 Consecutive Arthroscopic Rotator Cuff Repairs.
  - McNamara WJ1, Lam PH1, Murrell GA2.
  - Stiff group <20 ER PROM at 6 weeks post-surgery (n=285), nonstiff group >20 ER PROM (n=714)
  - Re-tears via US at 6 months
    - Stiff 19/285=7%
    - Nonstiff 107/714=15%
  - ***ROM measures were close to equalized at 6 months post-surgery with slightly greater motion in the nonstiff group***[12]

STIFFNESS AND OUTCOMES

- ***J Shoulder Elbow Surg. 2020 Feb 19. pii: S1058-2746(19)30799-2. doi: 10.1016/j.jse.2019.11.020. [Epub ahead of print]***
  - Shoulder stiffness after rotator cuff repair: the fate of stiff shoulders up to 9 years after rotator cuff repair.
  - Millican CR1, Lam PH1, Murrell GAC2
  - PROM assessment at 6 weeks post-op and upper and lower 15% ER groups identified (69 stiff, 69 non-stiff shoulders)
  - Followed consistently for minimum 2 years out of surgery, mean final follow-up on patients was 5 years +/- 0.2 years—some patients as late as 9 years
  - ***Stiff group was less likely to re-tear*** by 6 months post-op (3% and 19%) and long-term/overall (10% vs 30%)
  - ***No significant long-term difference in ROM, pain, satisfaction, or function*** (non-standardized assessment tools for pain, satisfaction, function)[13]

STIFFNESS AND OUTCOMES

- ***J Shoulder Elbow Surg. 2010 Oct;19(7):1034-9. doi: 10.1016/j.jse.2010.04.006. Epub 2010 Jul 24.***
    - Does slower rehabilitation after arthroscopic rotator cuff repair lead to long-term stiffness?
    - Parsons BO1, Gruson KI, Chen DD, Harrison AK, Gladstone J, Flatow EL.
  - 1year follow up on 10 “stiff” patients at 6 weeks (<100 deg forward elevation, < 30 deg ER PROM) vs. “nonstiff” patients (n=33)
  - ***No diff of active forward elevation, ER, IR***
  - ***No diff in ASES or Constant-Murley scores***
  - Repeat MRI revealed 70% intact in “stiff” group, vs 36% intact in “nonstiff” group[14]

STIFFNESS AND OUTCOMES

- ***Scand J Surg. 2014 Dec;103(4):263-70. doi: 10.1177/1457496913514383. Epub 2014 Apr 2***.
  - Postoperative stiff shoulder after open rotator cuff repair: a 3- to 20-year follow-up study.
  - Vastamäki H1, Vastamäki M2.
  - Retrospective record review of 416 open RCR's
  - 56 able to be assessed with essentially flexion/abd PROM<110 degrees and ER<35 at 5-6 weeks post-surgery compared to randomized control group of 61 patients
  - ***93% of ROM was equalized to control at 6 months, essentially100% at 1 year***
  - ***Mean 9 year follow-up, motion essentially equal in both groups***
  - ***Strength similar to contralateral shoulder at 1 year***[15]

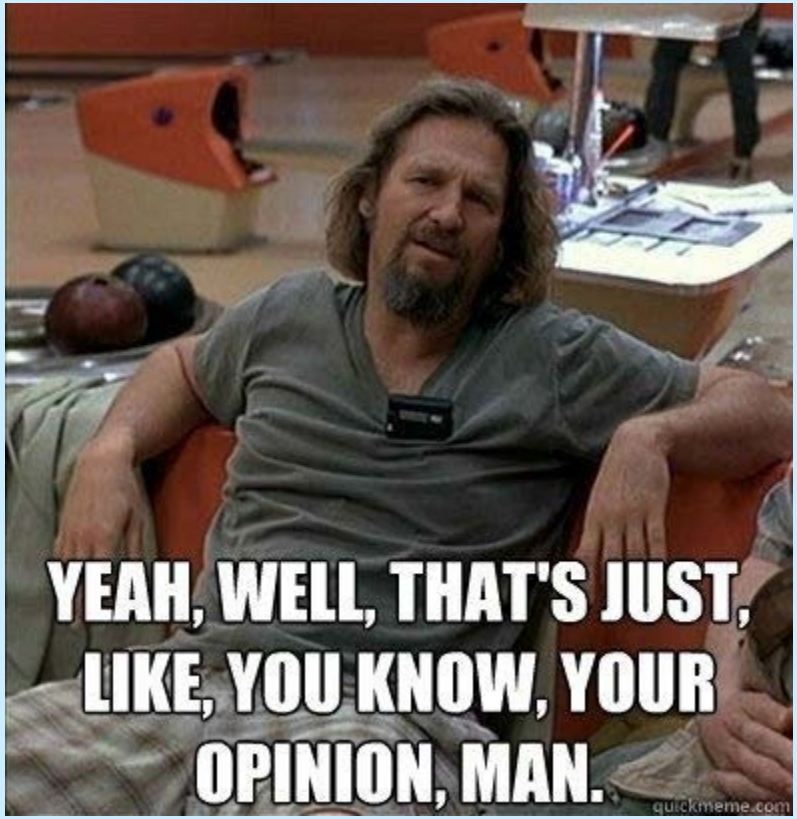
EVIDENCE FOR DELAYED PROM/REHAB PROGRESSION IS GROWING

- Medicine (Baltimore). 2018 Jan;97(2):e9625. doi: 10.1097/MD.0000000000009625. **The clinical effect of rehabilitation following arthroscopic rotator cuff repair: A meta-analysis of early versus delayed passive motion.** Li S[1], Sun H, Luo X, Wang K, Wu G, Zhou J, Wang P, Sun X.
- Am J Sports Med. 2015 Aug;43(8):2057-63. doi: 10.1177/0363546514552802. Epub 2014 Oct 8. **Early Versus Delayed Passive Range of Motion After Rotator Cuff Repair: A Systematic Review and Meta-analysis.** Kluczynski MA[1], Nayyar S[1], Marzo JM[1], Bisson LJ[2].
- Am J Sports Med. 2012 Apr;40(4):815-21. doi: 10.1177/0363546511434287. Epub 2012 Jan 27. **Is early passive motion exercise necessary after arthroscopic rotator cuff repair?** Kim YS[1], Chung SW, Kim JY, Ok JH, Park I, Oh JH.
- Am J Sports Med. 2015 May;43(5):1265-73. doi: 10.1177/0363546514544698. Epub 2014 Aug 20. **Early Versus Delayed Passive Range of Motion Exercise for Arthroscopic Rotator Cuff Repair: A Meta-analysis of Randomized Controlled Trials.** Chang KV[1], Hung CY[2], Han DS[3], Chen WS[2], Wang TG[2], Chien KL[4].
- J Shoulder Elbow Surg. 2017 Sep;26(9):1681-1691. doi: 10.1016/j.jse.2017.04.004. Epub 2017 Jun 12. **Does early motion lead to a higher failure rate or better outcomes after arthroscopic rotator cuff repair? A systematic review of overlapping meta-analyses.** Saltzman BM[1], Zuke WA[1], Go B[1], Mascarenhas R[2], Verma NN[1], Cole BJ[1], Romeo AA[1], Forsythe B[3].
- Am J Sports Med. 2017 Oct;45(12):2911-2915. doi: 10.1177/0363546517692543. Epub 2017 Mar 13. **Early Versus Delayed Motion After Rotator Cuff Repair: A Systematic Review of Overlapping Meta-analyses.** Houck DA[1], Kraeutler MJ[1], Schuette HB[1], McCarty EC[1], Bravman JT[1].

EVIDENCE FOR DELAYED REHAB

- **Conclusions of these studies**: Early PROM may improve motion early in recovery, but may increase risk of RC retear/improper tendon healing and seems to offer no specific benefit over delayed intervention. Lower quality meta-analyses indicate that tear size may have some effect on determining rehabilitation protocol.

Thank you



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- References

1. Boileau P, Brassart N, Watkinson DJ, Carles M, Hatzidakis AM, Krishnan SG. Arthroscopic repair of full-thickness tears of the supraspinatus: does the tendon really heal?. J Bone Joint Surg Am. 2005;87(6):1229-40.
2. Galatz LM, Ball CM, Teefey SA, Middleton WD, Yamaguchi K. The outcome and repair integrity of completely arthroscopically repaired large and massive rotator cuff tears. J Bone Joint Surg Am. 2004;86(2):219-24
3. Harryman DT, Mack LA, Wang KY, Jackins SE, Richardson ML, Matsen FA. Repairs of the rotator cuff. Correlation of functional results with integrity of the cuff. J Bone Joint Surg Am. 1991;73(7):982-9.
4. Duquin TR, Buyea C, Bisson LJ. Which method of rotator cuff repair leads to the highest rate of structural healing? A systematic review. Am J Sports Med. 2010;38(4):835-41.
5. Bishop J, Klepps S, Lo IK, Bird J, Gladstone JN, Flatow EL. Cuff integrity after arthroscopic versus open rotator cuff repair: a prospective study. J Shoulder Elbow Surg. 2006;15(3):290-9.
6. Gulotta LV, Rodeo SA. Growth factors for rotator cuff repair. Clin Sports Med. 2009;28(1):13-23.
7. Carpenter JE, Thomopoulos S, Flanagan CL, Debano CM, Soslowsky LJ. Rotator cuff defect healing: a biomechanical and histologic analysis in an animal model. J Shoulder Elbow Surg. 1998;7(6):599-605.
8. Lewis CW, Schlegel TF, Hawkins RJ, James SP, Turner AS. The effect of immobilization on rotator cuff healing using modified Mason-Allen stitches: a biomechanical study in sheep. Biomed Sci Instrum. 2001;37:263-8.
9. Miller BS, Downie BK, Kohen RB, et al. When do rotator cuff repairs fail? Serial ultrasound examination after arthroscopic repair of large and massive rotator cuff tears. Am J Sports Med. 2011;39(10):2064-70.
10. Burrus MT, Diduch DR, Werner BC. Patient-related Risk Factors for Postoperative Stiffness Requiring Surgical Intervention After Arthroscopic Rotator Cuff Repair. J Am Acad Orthop Surg. 2019;27(7):e319-e323.
11. Huberty DP, Schoolfield JD, Brady PC, Vadala AP, Arrigoni P, Burkhart SS. Incidence and treatment of postoperative stiffness following arthroscopic rotator cuff repair. Arthroscopy. 2009;25(8):880-90.
12. Mcnamara WJ, Lam PH, Murrell GA. The Relationship Between Shoulder Stiffness and Rotator Cuff Healing: A Study of 1,533 Consecutive Arthroscopic Rotator Cuff Repairs. J Bone Joint Surg Am. 2016;98(22):1879-1889.
13. Millican CR, Lam PH, Murrell GAC. Shoulder stiffness after rotator cuff repair: the fate of stiff shoulders up to 9 years after rotator cuff repair. J Shoulder Elbow Surg. 2020.
14. Parsons BO, Gruson KI, Chen DD, Harrison AK, Gladstone J, Flatow EL. Does slower rehabilitation after arthroscopic rotator cuff repair lead to long-term stiffness?. J Shoulder Elbow Surg. 2010;19(7):1034-9.
15. Vastamäki H, Vastamäki M. Postoperative stiff shoulder after open rotator cuff repair: a 3- to 20-year follow-up study. Scand J Surg. 2014;103(4):263-70.

Athens Orthopedic Clinic

EARLY MOTION AFTER ROTATOR CUFF REPAIR—SAFE AND REASONABLE.

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FACTORS THAT SHOULD DETERMINE THE PACE OF REHAB

- Size of tear?
- Retraction?
- Revision?
- Age?
- Dominant vs non-dominant?
- Smoker? Diabetes?

EMG ACTIVITY

- Passive ROM by therapist, pendulums/Codman's, and self guided ROM with dowel:
  - had less EMG activity of rotator cuff as compared to "rope and pulley", ambulation without sling, and donning/doffing of the sling.

- Rope and pulley:
  - higher EMG when in plane of scapula than in the sagittal plane

B. Gurney, C Mermier, M LaPlant et al; JOSPT, May 2016

"SAFE" EXERCISES?

- Retrospective study on all research up to June 2016
  - **20 of 2157** studies found to be relevant
  - Data compiled
- 9 "suitables"
  - re: early load of **supra**spinatus
- 10 "suitables"
  - re: early load of **infras**pinatus

P Edwards J Ebert C Littlewood et al, JOSPT, Dec 2017

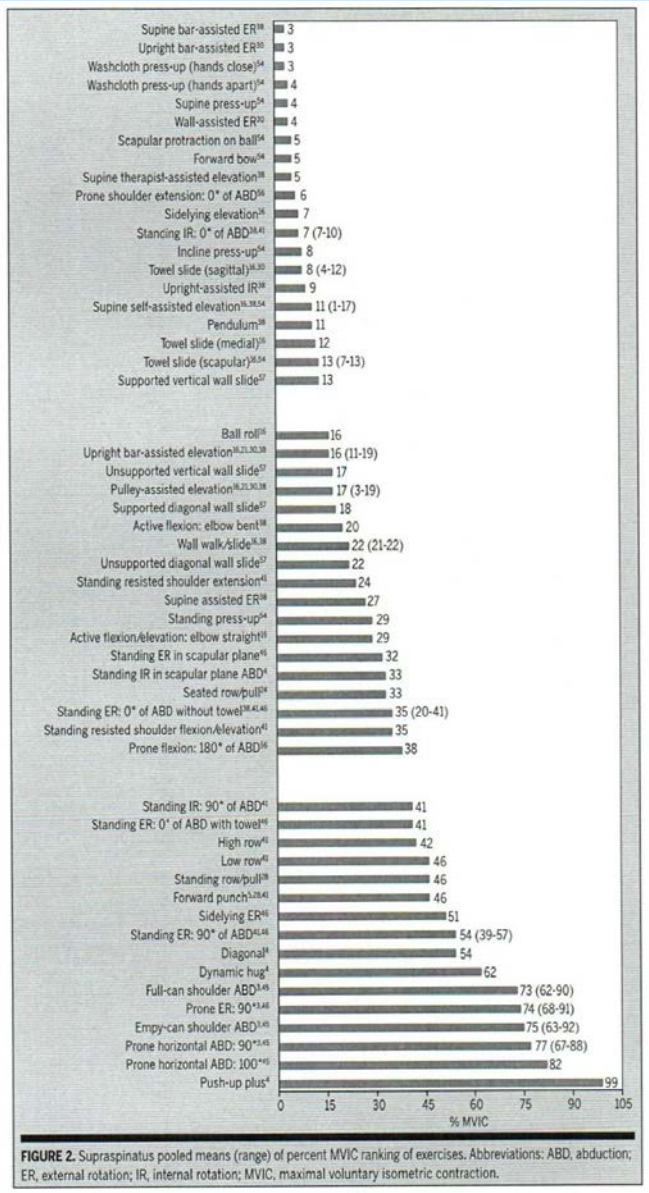


FIGURE 2. Supraspinatus pooled means (range) of percent MVIC ranking of exercises. Abbreviations: ABD, abduction; ER, external rotation; IR, internal rotation; MVIC, maximal voluntary isometric contraction.

% MVIC
LOW, MODERATE , AND HIGH

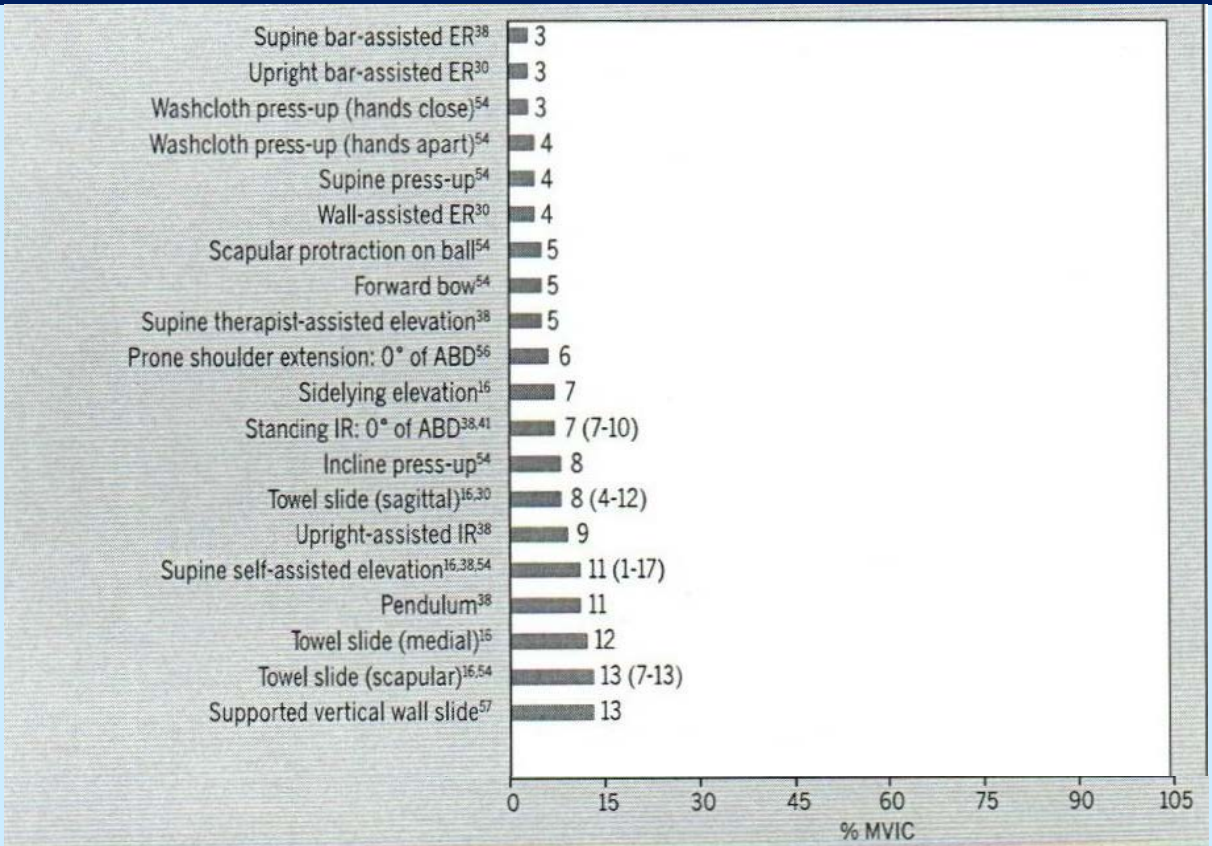
"Figure 2 depicts the pooled means for supraspinatus muscle activations during passive, active-assisted, active, and strengthening exercise"

"Overall, 20 exercises reported low-level muscle activation, and therefore were deemed appropriate to implement in early stage [rehab] following [RCR]"

LOW (15% MVIC)

- Supine T-bar ER= 3
- Therapy assisted supine elevation = 5
- Prone shoulder ext= 5
- Side lying elevation= 7
- Standing IR (0° abd)= 7
- Pendulum= 11
- Towel slide= 11 (sagittal), 12 (scapular)

LOW



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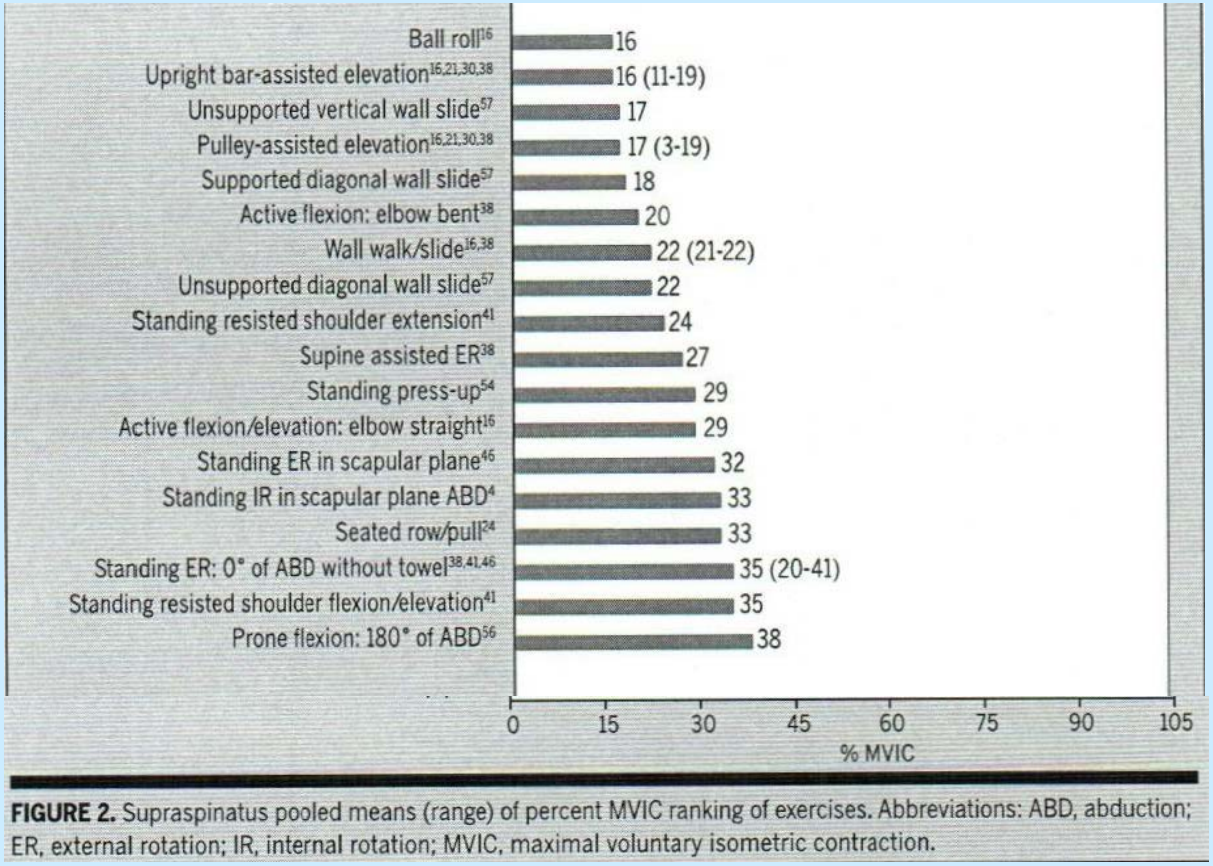
MODERATE

- Ball roll = 16
- Rope and pulley = 17
- Active flex (elbow bent) = 20
- Wall walk = 22
- Active flexion (elbow straight)= 27

MODERATE



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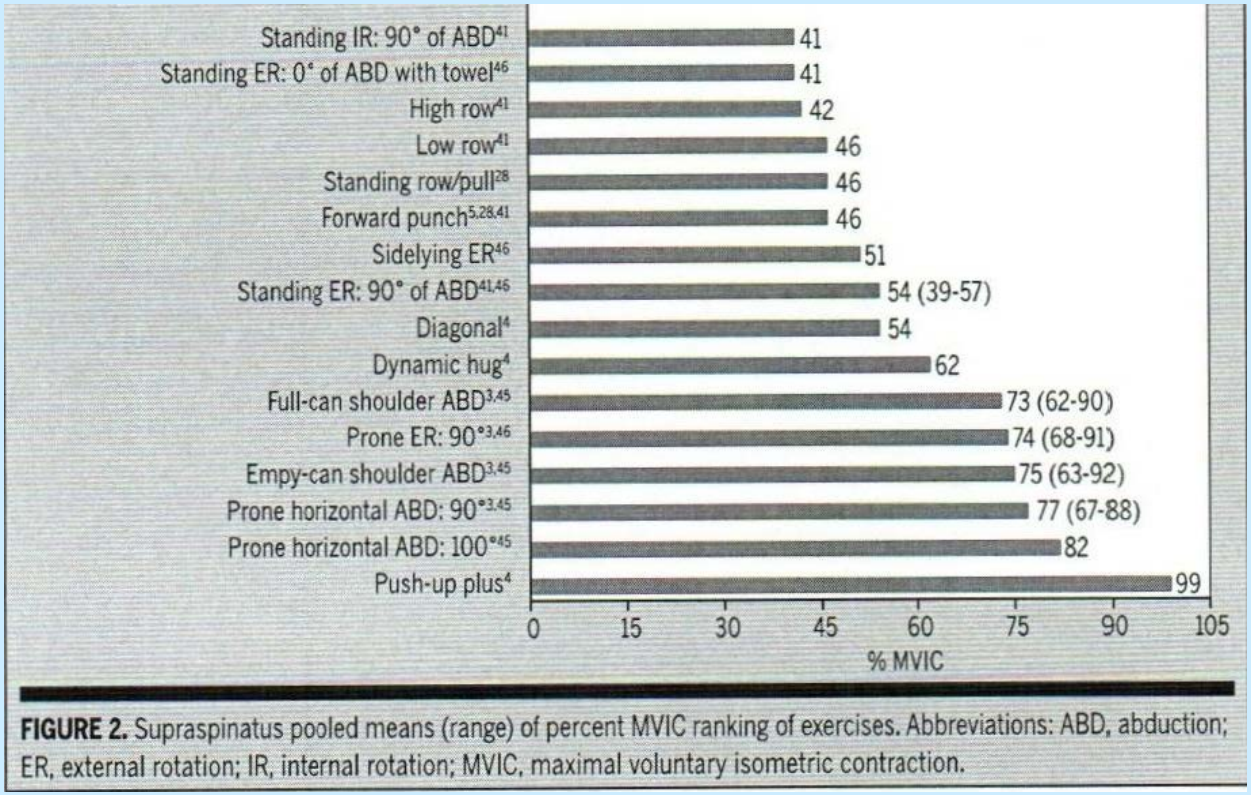
HIGH

- Standing row = 43
- Sidelying ER = 51
- Full can = 73
- Empty can = 75
- Horizontal abduction= 75
- Push up w plus = 99

HIGH



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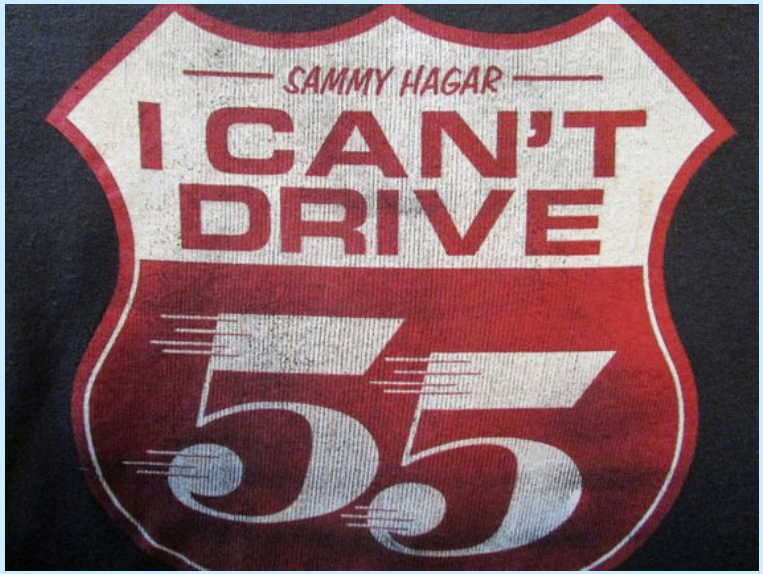
WARNING WITH EARLY MOTION

Generally, patients will "feel better" with EPM (not as stiff) as DPM (tight). Personal experience: these patients, perhaps unknowingly, will do more and would be more likely to risk reinjury



EPM V DPM

"EARLY" VS "DELAYED" PASSIVE MOTION

- Retrospective; meta-analysis
  - o ASES score and SST scores
- 8 randomly controlled studies
  - o **671** patients included
- **EPM**: better with short- and mid-term follow up
- **DPM**: as good or better (than EPM) with large tears
  - o (ASES scores)

S Li, H Sun, X Luo et al, Medicine 2018, 97:2

THANK YOU

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