

clinical conduit

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Inside this issue

Prognostic Factors that Influence RC Rehab	1
Plantar Intrinsic Training The "Short Foot" Exercise	1
Scapular Dyskinesia	2

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Prognostic Factors that Influence Rehabilitation Success Following Rotator Cuff Repair Surgery: Part 1



My orthopedic physical therapy residents and I recently conducted a comprehensive review of the literature on the factors that predict success following the surgical repair of the rotator cuff. We organized our findings into six categories and submitted our findings for publication in the *The Physician and Sportsmedicine*. The variables we discussed included tendon healing, restoration of strength and mobility, pain levels, patient satisfaction, and functional outcomes. While these factors are interdependent they each influence the final result. This first chapter describes the short

and long-term healing outcomes patients should anticipate based on their unique presentation.

The presence of rotator cuff tears is common and the incidence increases with advancing age. Whether symptomatic or not, it has been estimated that 25% of adults over the age of 60 will have a rotator cuff tear. Consequently; rotator cuff repair (RCR) is the most common shoulder condition that undergoes post-op rehabilitation. Each patient presents with unique traits and medical comorbidities that mandate a customized approach to their rehabilitation. Generic approaches to rehabilitation or strict adherence to inflexible post-op therapy protocols may make it more difficult to obtain a successful outcome. In addition, evolving research regarding post-op aggressiveness is constantly shifting based on new surgical repair techniques and up-

dated evidence regarding the best environment for tissue healing.

General guidelines include post-op immobilization to allow tendon healing and avoidance of excessive tensile strain on the repair until the musculotendinous attachment integrates into bone. Repaired tendons should avoid stress for a minimum of 2-3 months. This paper will review the current literature on pre-op factors that may influence post-op outcome following rotator cuff repair. Outcome success should be judged in light of the patient's satisfaction, improved pain, self-report of function, restoration of strength and mobility, and the presence of tendon to bone healing. The clinician must constantly balance protecting the tendon's integrity while restoring the mobility and strength to allow painless overhead function.

- continued on page 2

Plantar Intrinsic Training – The Short Foot Exercise

We recently completed an interesting investigation on the impact of plantar intrinsic muscle training on arch morphology and dynamic function. Here is a brief summary of some of our findings. This study was a single-group repeated measures pre-and post-test design that evaluated the effectiveness of a specific exercise training program's ability to influence navicular drop in a relaxed stance position. Previous research has suggested that a training regimen emphasizing the neuromuscular recruitment of the plantar intrinsic foot muscles, colloquially referred to as "short foot" exercise training, is a contributor to supporting the medial longitudinal arch in weight-bearing positions. The short foot exercise was described in an earlier issue of this newsletter (Volume 3, Issue 5). The purpose of this study was to determine if a 4-week intrinsic foot muscle training program would alter the navicular drop in a group of asymptomatic subjects.



For subjects we used a sample of convenience of 21 asymptomatic volunteers for the study. The 3 men and 18 women were 26.1 ± 3.7 years old and had no sign of foot pain, history of patellofemoral pain syndrome, plantar fasciitis, anterior or posterior tibialis dysfunction, or evidence of severe neurological disease within the past six months. None of the subjects had previous personal experience with the specific plantar intrinsic foot training method utilized in the study.

- continued on page 4

Rotator Cuff Success Prognosis: Tendon Healing continued

REFERENCES

All references are available on line at www.continuing-ed.cc/newsletter.htm

A number of intrinsic and extrinsic risk factors have been associated with re-tears following a RCR. These factors include age, gender, smoking, medical comorbidities, and rotator cuff characteristics (i.e. chronicity, size, retraction, degree of fatty atrophy). It is important to recognize and modify post-op rehabilitative programs to accommodate these concerns. The literature offers convincing evidence that poor healing and higher failure rates are more common as the age of the patient increases. Papadopoulos found that patients were on average 15 years younger than those who sustained a recurrence of their tear. Additionally, Boileau and Charrouset found an increased risk for failed tendon healing in patients over the age of 65 (Figure 1). Oh found a worse anatomic outcome was associated with patients who were older but this independent variable did not correlate with the functional outcome. It is generally believed that individuals over the age of 40 have a decreasing microcirculation at the supraspinatus musculotendinous junction that impacts healing rates. Tashjian found that aging was the most influential biological limitation even after maximizing the repair's biomechanical strength with a double-row fixation construct.

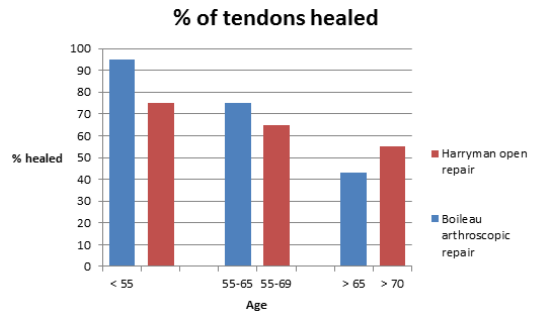


Figure 1

While the mechanisms of these precipitous changes are unclear, the negative impact of decreased vascularity on healing is similar with smokers. Mallon found that compromised small vessel circulation is common in smokers and may account for the decreased healing rate. Similarly, both Kane and Baumgarten found that smoking increased the risk of a rotator cuff tear while Carbone found that the total years of smoking affected the size of the tear.

- continued on page 3



**Question of the Month:
Scapular Dyskinesia**

How do you evaluate for abnormal scapular motion?

V.K., PT



Visual inspection of the resting position of the scapula and the scapulohumeral rhythm that accompanies active elevation is an important element of any shoulder examination. Until about a decade ago I would use the lateral scapular slide test described by Kibler to objectively measure scapular asymmetries but have since converted to the scapular dyskinesia classification. The shortcoming of this categorization scheme is its poor reliability within and between examiners.

We recently submitted a poster to the TPTA Annual Conference this fall in San Antonio that I think addresses your question. Here is what we found. Assessment of the scapula's contribution to functional activities of the upper extremity is a common examination strategy. Altered scapulothoracic mobility and/or poor neuromuscular control are thought to be under-

lying impairments that can lead to functional limitations and result in activity restrictions. Multiple previous investigators have attempted (and failed) to find a reliable method of evaluating this phenomenon. The purpose of this investigation was to contrast the intra and inter-rater reliability of student and licensed physical therapists in classifying scapular dyskinesia.

We recruited 6 healthy volunteers for this pilot study between the ages of 22-25. All subjects were right handed. Each subject performed 5 scapular plane elevation maneuvers while holding a 2 lb. dumbbell. 11 examiners (6 licensed PTs and 5 student PTs) independently assessed scapular motion. Intra and inter-rater kappa coefficients were calculated for 1) classifying each scapula into one of four pre-defined categories; 2) classifying each scapula's motion as normal or

abnormal; and 3) classifying whether or not the scapula motion was symmetrical. Further analysis was conducted to differentiate performance by student versus licensed physical therapists.

We analyzed the with multi-rater kappa, κ , statistics to measure agreement between examiners. The κ value is a chance-adjusted measure of agreement. A κ of 0.00 represents agreement equivalent with random chance alone, whereas a κ of 1.00 represents perfect agreement.

We found low reliability for all inter-examiner analyses. In classifying each scapula as one of 4 types, overall reliability was $\kappa = 0.13$, licensee reliability was $\kappa = 0.22$, and student reliability was $\kappa = 0.15$. Reliability improved to fair when the observer was only required to decide between normal and abnormal scapular motion with an overall $\kappa = 0.21$ (license holders at $\kappa = 0.37$ and students a $\kappa = 0.27$).

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References

All references are available on line at www.continuing-ed.cc/newsletter.htm



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Pendulum exercise. A) Performed incorrectly with active contraction of the shoulder muscles to create circumduction at the glenohumeral joint.

B) Performed correctly; patient leaning forward at the waist allowing the arm to passively swing at the glenohumeral joint as weight shifting causes the trunk to undulate

Rotator Cuff Success Prognosis: Tendon Healing continued -

A number of concurrent medical conditions have been linked to an increased risk for rotator cuff pathology and are impactful in the healing of the repaired tendons after surgical repair. Impaired healing is common in the diabetic population and the effect of poor glycemic control has been shown to negatively alter tendon-bone healing in animal studies. From a structural integrity standpoint, Chung found on multivariate analysis that diabetic patients had a higher post-op failure rate. In the same study, the sole independent variable that predicted higher healing failure rates was decreased bone mineral density as in patients with osteoporosis. It is postulated that the strength of the RCR may be compromised by the decreased bone quality and reduced pull-out strength of the suture anchors.



Cardiovascular comorbidities may also influence the healing of the tendon. A case-control study identified hypertension as a significant risk factor for the occurrence and severity of rotator cuff tears. While this study did not specifically evaluate post-op healing it does suggest that hypertensive subjects are 2-4 times more likely to have large to massive rotator cuff tears which have been associated with a decreased likelihood for healing. In a study of the Achilles tendon, researchers identified a link between dyslipidemia, which is a characteristic of insulin resistant diabetes, and the presence of tendinopathy. It may be that the typical body habitus of individuals with metabolic syndrome (elevated waist circumference or an elevated waist to hip ratio) have an impaired healing capacity and predisposition to increased intramusculo-tendinous lipid deposition.

The chronicity of the injury prior to the surgery may also be a predictor of the ability for a repair to heal. Detached tears undergo time-dependent, permanent physiological changes including atrophy, infiltration of fat, retraction, and fibrous contraction. Both the amount of tear retraction and degree of fatty infiltrate has been associated with a higher failure rate. In fact; Oh reported that the fatty degeneration of the infraspinatus muscle served as an independent predictor of the post-op integrity of the rotator cuff. Finally, Goutallier reported that a fatty degeneration index (the mean of the fatty degeneration grades in the supraspinatus, infraspinatus, and subscapularis muscles) greater than 1.5 was associated with an 80% tear recurrence.

Recent efforts to augment biologic healing have led to the development of platelet-rich plasma (PRP) and rotator cuff patches; however, to date the efficacy of these enhancements are unclear. In a systematic review with quantitative analysis, Chahal did not find an overall effect on re-tear rates or shoulder-specific functional outcomes. Sub-analysis did find that PRP application in small to medium size tears resulted in a larger percentage of patients with structural healing of the rotator cuff. However, it is important to note that both Barber and Jo reported there were no differences in clinical outcomes or an accelerated recovery with respect to pain, range of motion (ROM), strength, or decrease in pain during the rehabilitative process. Preliminary investigations regarding synthetic augmentation have yet to identify the ideal scaffold to induce host tissue ingrowth and tendon regeneration. It appears that other variables may be more important biological factors in predicting healing status but Abrams recommends that surgeries with biological augmentation, particularly those with revisions, have a longer immobilization period and a delay with initiating passive elevation ROM exercises.

Probably the most influential risk factor for structural failure of the repair is the size and morphological features of the tear prior to surgery. Multiple authors have concluded that larger tears have the highest failure rates. Abrams reported that multi-tendon tears heal in the range of 50-65% of the time, while single tendon tears heal 80-90% of the time. In a prospective analysis of arthroscopic rotator cuff repairs, Nho reported that for every centimeter increase in tear size the odds of a post-op tendon defect doubled. These authors also reported that there was a nine-fold greater likelihood of repair failure in multiple-tendon tears as compared to single-tendon tears. Similar results have been found in a series of open cuff repairs with a healing rate of 80%, 57%, and 32% for single, double, and triple tendon tears respective. Post-op tendon integrity is also influenced by surrounding tissue pathologies. Nho found that biceps degeneration, acromioclavicular joint pathology, and poor tissue quality were associated with persistent repair defects following surgery.

It is our recommendation that patients with any risk factor that favors the likelihood of a poor healing response maximize the post-op immobilization phase. These patients should be immobilized for a full 6-weeks in an abduction sling that places the joint in the resting position with minimal tension on the repair. Care should be taken to limit the arc of motion during correctly performed pendulum exercises to a 20 cm diameter (Figure to left). Additionally, routine use of the sling-supported arm in everyday activities such as typing, drinking, and brushing the teeth should be discouraged with the involved arm. If necessary, early passive motion activities should be taught and supervised by experienced rehabilitation specialists. **The next issue will present prognostic factors that impact post-operative stiffness and restoration of motion.**

Previous issues are archived at
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"In my experience a therapist that cannot take a good history and a patient who cannot give one results in a poor prognosis."



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Plantar Intrinsic Training continued from page 1 -



The subjects were examined by an orthopedic physical therapy resident and navicular drop (reliability established in pilot testing) was evaluated in a standard manner. The navicular drop value was defined by the navicular's height in a sitting position with the STJ in neutral minus their navicular height in a relaxed stance position.

The 42 feet were dichotomized into two groups ($>$ or $<$ 15 mm navicular drop at baseline) for comparison on the effect of a 4-week short foot exercise training program. All subjects then completed a 3-minute, daily sensorimotor exercise program (85% daily compliance) that progressed from a sitting position to bilateral and unilateral stance positions. All subjects were re-evaluated at 4 weeks and 8 weeks to see if a carryover effect was present after the exercise intervention had ceased at 4 weeks.

13 feet had greater than a 15 mm drop at baseline assessment and 29 feet had less than a 15 mm drop. The "excessive" drop group had a mean baseline drop of 19.7 ± 2.9 mm while the "normal" drop group had a mean drop of 9.6 ± 4.2 mm. Following 4 weeks of exercise training the feet demonstrating excessive arch collapse at baseline showed a significant improvement in navicular drop decreasing by nearly 6 mm to $13.9 \text{ mm} \pm 5.2$ ($p < 0.001$) while the normal group showed no significant change in navicular drop ($p = .89$). At 8 weeks there were no significant changes in either group from the 4-week assessment suggesting that the improvement in the group with excessive navicular drop was maintained.

This study shows that a 4-week neuromuscular training program emphasizing recruitment of the plantar intrinsic muscles decreases navicular drop in feet with excessive compensatory STJ tendencies. Intrinsic foot muscle training may have an adjunctive role in preventing excessive navicular drop and be considered as an important part of a comprehensive approach to addressing abnormal hyperpronation mechanics in the lower extremity. This study offers preliminary evidence to suggest that short foot exercise training may have value in supporting the medial longitudinal arch in a specific subset of an asymptomatic subject population. Further research regarding the value of this exercise intervention in pathology specific patient populations is warranted.



Scapular Significance continued from page 2 -

Agreement on symmetry between each subject's scapular classification was very low with an overall $\kappa = 0.03$. Although still classified as only fair agreement, κ values were much higher when assessing the subject's non-dominant side as compared to the dominant side.



Scapular classification into one of four categories was $\kappa = 0.28$ for the non-dominant, left side as compared to $\kappa = 0.02$ on the right side for licensed examiners. Intra-examiner reliability was also low. Intra-examiner kappa coefficients ranged from -0.35 to 0.72. Licensed examiners kappa coefficients ranged from -0.02 to 0.72 while student examiners ranged from -0.35 to 0.65. Only two examiners had intratester κ values over .60 indicating "good" reliability.

The low reliability results in this study are similar to previously reported findings. Future research needs to focus on alternative methods of evaluation including the morphological factors that influence the consistency of the test. Investigations that evaluate the benefit of palpation in conjunction with the visual assessment, emphasis of multiple arcs and planes of motion during the assessment, and develop better operational definitions of the scapular dyskinesis patterns will be forthcoming. Additionally, better understanding of characteristics by the examiner and how classification decisions are made require further study. At this time visual classification of scapular movement dysfunctions is an unreliable assessment methodology and should not be used as a sole criterion for diagnostic or intervention decisions.

If you'd like more information on this topic you might find our home study titled "Scapular Significance" to be of interest. This inservice can be read and/or viewed free of charge. A post-test for CEU credit is available at <http://www.continuing-ed.cc/homestudy.htm> for a reasonable fee.

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