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Editorial

Beyond the Labrum: Rethinking Posterior Impingement and SLAP Lesions in the Elite Tennis Shoulder

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The modern tennis serve is one of the most violent and biomechanically demanding motions in sport. At peak performance, the shoulder is exposed to extreme abduction and external rotation, rapid deceleration forces, and repetitive torsional stress that test the limits of anatomical tolerance. Yet, paradoxically, most elite players remain asymptomatic for years despite demonstrable structural abnormalities on imaging. This paradox should prompt reflection. Posterior internal impingement (PII) and superior labrum anterior-to-posterior (SLAP) lesions have traditionally been framed as discrete pathological entities, lesions to diagnose, classify, and repair. However, accumulating clinical experience and biomechanical evidence suggest a different interpretation: these conditions are often not isolated structural failures, but rather the biological footprint of a dysfunctional kinetic system. If outcomes in elite tennis players are to be improved, our conceptual framework must evolve accordingly.

Adaptation is not injury—until it is. The overhead athlete's shoulder is defined by adaptation. Increased humeral retroversion, gain in external rotation, posterior capsular tightness, and glenohumeral internal rotation deficit (GIRD) are well-documented findings in high-level players. These changes may enhance performance by allowing greater energy storage and release during the cocking phase. But adaptation has a threshold. The classical descriptions of posterior impingement by Walch et al.[1] and the expanded spectrum proposed by Jobe[2] emphasized contact between the greater tuberosity and the posterosuperior glenoid during abduction and external rotation (ABER). Later, Burkhart et al.[3] highlighted the central role of posterior capsular contracture and the shift in glenohumeral contact point as drivers of pathological impingement. What has become increasingly clear is that posterior internal impingement is rarely purely intra-articular. It reflects a breakdown along the kinetic chain: deficits in lower-limb power transfer, trunk rotation asymmetry, scapular dyskinesis, and neuromuscular imbalance.[4] The shoulder becomes the terminal victim of proximal inefficiency. The key clinical question, therefore, is not simply whether impingement exists but why the adaptive balance has been lost.

Since the original description of SLAP lesions by Stephen J. Snyder [5], the orthopedic community has faced an ongoing dilemma: when does labral pathology require repair, and when is it merely an incidental finding? Advances in magnetic resonance imaging have dramatically increased detection rates. Yet higher diagnostic sensitivity has not translated into uniformly improved outcomes. In the early 2000s, SLAP repair rates surged, particularly in the United States. Subsequent outcome studies, however,

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revealed sobering realities: persistent pain, unpredictable return-to-play rates, and significant revision rates in overhead athletes.[6,7] The labrum, in many elite tennis players, may represent the endpoint of abnormal biomechanics rather than the primary driver of dysfunction. The "peel-back" mechanism and torsional overload of the biceps anchor occur within a system already stressed by capsular tightness, altered scapular control, and repetitive deceleration demands. Anatomical repair, while intuitively appealing, does not necessarily restore high-level performance or mechanics. This disconnect has fueled growing interest in biceps tenodesis among selected populations, particularly older athletes and revision cases. Yet even tenodesis should not be viewed as a panacea.[8] The broader lesson is sobering: structural normalization does not automatically equate to functional restoration.

Modern imaging has transformed diagnostic precision, but it has also complicated clinical reasoning. Asymptomatic overhead athletes frequently demonstrate articular-sided cuff fraying, posterosuperior labral irregularities, and MRI findings consistent with internal impingement. The mere presence of structural changes does not establish causality. This challenges a surgery-first mentality. The clinical examination, including the assessment of rotational arc symmetry, posterior shoulder tightness, scapular positioning, and kinetic chain sequencing remains indispensable. Imaging must inform, not dictate, decision-making. We must resist the temptation to operate on images rather than patients. The future lies in integration: combining structural imaging with objective biomechanical assessment and load monitoring to distinguish adaptive remodeling from pathological breakdown.

Conservative treatment remains the cornerstone of management in overhead shoulder injuries.[9] However, rehabilitation must evolve beyond generic rotator cuff strengthening. Elite tennis demands explosive lower limb drive, coordinated trunk rotation, scapular stability, and finely tuned neuromuscular timing.[10] Rehabilitation programs must therefore address:

- Restoration of total rotational arc balance
- Targeted posterior capsule mobility
- Quantitative scapular control training
- Core and lower extremity power integration
- Progressive interval serving protocols with load monitoring

The objective is not merely symptom resolution, but restoration of mechanical efficiency. Moreover, prevention strategies deserve equal emphasis. Routine screening for significant GIRD, scapular dyskinesis, and posterior capsule contracture may identify players at risk before structural injury manifests. The greatest gains in athlete longevity may come not from better surgical techniques, but from earlier biomechanical correction.

When nonoperative management fails, surgical intervention must be carefully individualized. Evidence suggests that isolated SLAP repair in high-level overhead athletes carries variable outcomes, particularly beyond the third decade of life.[6,7] Biceps tenodesis has demonstrated promising functional results in selected cases, yet even here, postoperative kinetic chain rehabilitation remains critical.[8] Perhaps the most important responsibility of the surgeon is to be transparent. Return to play at the preinjury level is not guaranteed. Persistent discomfort during high-load serving may remain despite technically successful procedures. Expectations must be realistic, especially in professional or elite players whose performance margins are razor-thin. In this context, restraint may be as important as technical skill.

Current literature remains dominated by single-center case series with heterogeneous reporting of outcomes. Multicenter prospective studies are urgently needed to identify:

- Predictors of success after conservative management
- Biomechanical thresholds distinguishing adaptation from pathology
- Standardized return-to-play criteria
- Long-term comparative outcomes of SLAP repair versus tenodesis in elite tennis populations

Emerging technologies, such as three-dimensional motion capture, wearable load sensors, and artificial intelligence-assisted biomechanical modeling, offer unprecedented opportunities. Machine learning algorithms may soon detect subtle kinetic inefficiencies long before clinical symptoms emerge. Such advances could shift our paradigm from reactive lesion management to proactive preservation of performance.

The elite tennis shoulder is not merely a joint; it is the terminal expression of a highly integrated kinetic chain.[4,10] Posterior internal impingement and SLAP lesions are not isolated enemies to be excised, but signals of system overload. As tennis continues to evolve—with faster serves, greater topspin, and denser competition calendars—the demands on the shoulder will only increase. Our management strategies must evolve as well. The future of overhead shoulder care lies not in more anchors or stronger sutures, but in deeper understanding. If we embrace a systems-based, function-driven model, we may finally align surgical decision-making, rehabilitation science, and performance optimization. The challenge before us is not simply to repair tissue. It is to preserve the extraordinary biomechanical harmony that allows the elite tennis athlete to serve at 220 kilometers per hour again and again.

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