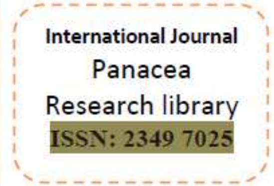

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EVIDENCE-BASED INTEGRATIVE REHABILITATION ON ROTATOR CUFF INJURIES: AN APPROACH COMBINING MODERN ORTHOPEDIC CONCEPTS, PHYSIOTHERAPEUTIC EXERCISES, AND AYURVEDIC MANAGEMENT

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ABSTRACT

Rotator cuff (RC) injuries are a common cause of shoulder pain and functional impairment, affecting up to 16–26% of adults [1]. Overhead work, aging and metabolic factors (e.g. diabetes) predispose to tendon degeneration. Modern management (NSAIDs, injections, structured physiotherapy) yields symptom relief but incomplete recovery. In *Ayurveda,* such shoulder syndromes are mapped to *Snāyugata Vāta* and *Avabahuka,* Vata-dominant disorders of tendons and shoulder. This review integrates orthopedic and Ayurvedic concepts: it outlines epidemiology, anatomy, and combined etiopathogenesis; highlights clinical features and diagnostic tests; and details stage-wise interventions. An evidence-based phased exercise programme is described (with strengthening, mobility and stabilization exercises [6]), alongside *Ayurvedic* treatments *Abhyanga* (oil massage), *Swedana* (fomentation) *Nasya, Basti (*enemas), *Agnikarma,* and *rasayana* medicines [7] [8]. We

propose a 3-stage integrative protocol and note gaps in high-quality evidence for *Ayurvedic* therapies, recommending rigorous trials to validate combined rehabilitation strategies.

KEYWORDS: Rotator cuff, Shoulder pain, Physiotherapy, *Snāyugata Vāta, Avabahuka,* Integrative rehabilitation,

EPIDEMIOLOGY AND BURDEN

Shoulder pain affects a large portion of the population (~16–26%) [1], and rotator cuff disorders (tendinopathy, tears) account for a majority of chronic cases. Rotator cuff pathology is attributed to up to 70% of persistent shoulder pain [2]. The prevalence of cuff tears rises with age and comorbidity (diabetes, hyperlipidaemia); imaging studies suggest 22% of older adults have some cuff tear (many asymptomatic). Occupations requiring repeated overhead activity (construction, sports) have higher incidence. Shoulder dysfunction from RC injury severely limits daily activities and work, especially in middle-aged and elderly groups.

ANATOMY AND BIOMECHANICS

The rotator cuff comprises the supraspinatus, infraspinatus, teres minor and subscapularis muscles inserting on the humeral head, providing dynamic stabilization during shoulder motion. These tendons pass under the coracoacromial arch; any narrowing (e.g. acromial spur) may mechanically compress the cuff (impingement). Normal glenohumeral motion follows a scapulo-humeral rhythm (approximately 2:1 rotation of humerus to scapula during arm elevation). Rotator Cuff tears disrupt force balance: deltoid activity causes superior humeral migration, leading to subacromial encroachment and pain. Chronic degeneration (fibril thinning, neovascularization) further compromises biomechanical integrity.

ETIOPATHOGENESIS: MODERN PERSPECTIVE

Rotator cuff pathology has a multifactorial origin. Intrinsic factors include tendon degeneration due to age-related poor blood supply, collagen disorganisation, genetic predisposition and metabolic influences (e.g. glycation in diabetes). Extrinsic factors involve repetitive overhead use (microtrauma from lifting, throwing), acute trauma (fall on outstretched arm), and anatomical impingement (hooked acromion). Smoking and metabolic syndrome also correlate with tendon pathology. Over time these factors lead to tendon microtears, inflammation and eventual partial or full-thickness tears. Biomechanically,

rotator cuff tears impair humeral head centering, perpetuating a cycle of pain and dysfunction.

AYURVEDIC CONCEPTS

In *Ayurveda,* chronic shoulder pain and rotator cuff damage are classically grouped under *Snāyugata Vāta* (*Vata* vitiation in tendons/ligaments) and *Avabahuka* (periarthritis of shoulder)[1][2]. The shoulder is considered an *Amsa Marma* (vital point); injury to its *Snāyu* (tendon) leads to *Vata* dominant symptoms. *Avabahuka* is described with symptoms of *Shula* (pain), *Stambha* (stiffness), *Gaurava* (heaviness), and restricted *Bahuprasharaṇa* (arm abduction)[2][1]. Classical texts note difficulty in lifting the arm (*bahuprasharaṇa-akṣamata*) in this condition[3]. *Ayurvedic nidāna* (causes) include *ati-vyāyāma* (overexertion), trauma, *vātvardhaka āhāra-vihāra* (vata-aggravating diet/lifestyle), and ageing[4] paralleling modern risk factors of repetitive strain, metabolic imbalance (like diabetes) and degeneration. Thus *Avabahuka* is viewed as a spectrum of *Vata-pradhāna* shoulder disorders, aligning closely with rotator cuff tendinopathy, bursitis, and adhesive capsulitis[2][1].

CLINICAL FEATURES

Clinically, rotator cuff injury presents with insidious shoulder pain (often lateral/anterior), exacerbated by overhead activity and lying on the affected side, and night pain. Early symptoms include pain during the painful arc (60–120° abduction) and positive impingement tests (Neer's, Hawkins-Kennedy). As pathology progresses, patients develop weakness (especially in active abduction and external rotation, e.g. positive Jobe's empty-can test) and limited range of motion. Supraspinatus atrophy or deltoid contour loss may become apparent. In *Ayurveda*, such patients exhibit *Shula* (pain), *Stambha* (rigidity), *Gaurava* (heaviness) and difficulty in arm abduction[1].

DIAGNOSTICS

Diagnosis begins with history and physical examination. Special tests (Neer, Hawkins, painful arc, Jobe's, Patte/GERBER's lift-off) help localize rotator cuff pathology, but have moderate sensitivity/specificity. Imaging confirms diagnosis: plain radiographs are usually normal except in chronic cases (may show acromial spurs or osteophytes). Ultrasonography is often first-line: it has high diagnostic accuracy for cuff tears (pooled sensitivity 84% for partial-thickness, 96% for full-thickness tears; specificity 89% and 93% respectively). MRI provides

detailed soft tissue assessment (tear size, retraction, muscle atrophy) and is reserved for surgical planning or unclear cases. Ultrasound's advantages are lower cost, dynamic real-time assessment and comparable accuracy for full tears.

MODERN CONSERVATIVE TREATMENTS

Initial management is typically conservative. Analgesics and NSAIDs reduce inflammation and pain, facilitating participation in rehabilitation (though they do not reverse tendon pathology). Subacromial corticosteroid injections can provide moderate short-term pain relief (3–6 weeks), but multiple trials show no sustained benefit beyond this period. Biologic injections (e.g. platelet-rich plasma) are increasingly used: recent meta-analyses report significant short-term pain reduction and functional improvement versus placebo in partial-thickness tears, although high heterogeneity of protocols tempers conclusions. Corticosteroids are best used sparingly (to avoid tendon weakening). All treatments include load management: activity modification (avoiding aggravating overhead tasks) and gradual return to activity guidance. Patient education on posture and ergonomics is essential to prevent recurrence.

PHYSIOTHERAPEUTIC REHABILITATION PROGRAM

Rehabilitation follows a phased progression from pain control to strength and function. The general phase-wise program is as follows:

- **Phase I (Acute/Pain Control, 0–6 weeks)**: Goals are pain relief and maintenance of passive mobility. Continue gentle pendulum exercises; begin assisted ROM (passive/active-assist flexion, abduction to pain-free range). Isometric exercises of deltoid and rotator cuff (e.g. sub-maximal "pushing" against immovable object) can be initiated as tolerated. Modalities (ice, gentle mobilization) may augment comfort. Emphasize scapular setting (shoulder blade stabilization) to prevent compensatory motion. Avoid activities or positions that exacerbate pain.
- **Phase II (Subacute/Mobility, 6–12 weeks):** Goals are restore full ROM and begin strengthening. Progress to active ROM stretching (flexion, abduction, external/internal rotation within tolerance). Introduce resistance exercises: elastic bands or light weights for rotator cuff (external rotation, internal rotation, scaption), deltoid (lateral raises), and scapular stabilizers (rows, scapular squeezes).

Incorporate closed-chain exercises (wall push-ups). Continue posture and scapular control training. Core stability exercises are also beneficial to enhance overall shoulder control.

- Figure: Core stabilization (bird-dog exercise) improves scapular support and trunk control, aiding shoulder mechanics.
- **Phase III (Strengthening/Function, >12 weeks):** Goals are normalization of strength and function. Increase resistance (therabands progressing to dumbbells or machines) for all shoulder muscles. Add dynamic and proprioceptive exercises (theraball catches, rhythmic stabilization). Begin functional/plyometric drills (medicine ball throws, pulley pulleys). Work on overhead and sport-specific activities as appropriate. At this stage, strengthening of the entire shoulder complex and upper back (e.g. shoulder press, lat pulldown, rowing) is emphasised.

  A suggested exercise progression table is given below for clarity (see Table 2). Emphasis is on controlled progression: from isometrics and gentle ROM to eccentric strengthening and dynamic activities.

AYURVEDIC MANAGEMENT

Ayurvedic management complements rehabilitation via *Vata* pacifying, tissue nourishing therapies. Key approaches include:

- External *Snehana* (Oleation) and *Swedana* (Sudation): Warm oil massage (e.g. *Mahanarayana Taila, Kshirabala Taila*) over the shoulder and neck region nourishes *Snāyu* (tendons) and relieves stiffness[7]. This is often followed by gentle heat therapy: *Swedana* such as *Sahacharadi or Dhanyamla pinda* (herbal bolus) fomentation to alleviate *Vata* induced stiffening[8]. *Panchakarma* classics list *abhyanga* and *swedana* among first-line measures for *Avabahuka*[8][7].
- *Agnikarma* (Localized Thermocautery): Targeted thermal cautery (e.g. on specific tender points or muscle insertions) has been reported to give rapid pain relief in chronic shoulder conditions[9]. This should be performed by experienced practitioners in appropriate cases (e.g. localized *Vata* pain).
- *Nasya* (Nasal Therapy): Instillation of medicated oils (e.g. *Anu Taila, Mahatikta Ghrita*) via nostrils helps reduce *Urdhwanga Vata* (upper body *Vata*) and is believed to relieve

stiffness and pain in the shoulder girdle[7]. *Nasya* is usually administered daily or on alternate days during the active treatment phase.

- *Vasti* (Medicated Enemas): Therapeutic enemas are considered the prime treatment for *Vatavyadhi*. In shoulder disorders, *Matra Basti* (oil enema) or *Yapana Basti* (nutritive enema) using decoctions like *Dashamoola* or *Bala Paka* are given to pacify systemic *Vata* and nourish muscle/tendon tissues. *Ksheerabala Basti* (milk and bala decoction) is often used for tissue regeneration in atrophic cases[8].
- Internal Medications: Classical *rasayana* and *ruksha* (anti-Vata) formulations are prescribed. Common choices include *Rasnasaptakam Kashayam, Maharasnadi Kashayam,* and *Guggulu* preparations (e.g. *Yogaraja Guggulu, Maharasnadi Guggulu*) for pain relief and *Vata* balancing[10]. *Dashamoola* decoction (ten-root combination) is used for inflammation, and herbs like *Bala* (*Sida cordifolia*) or *Ashwagandha* for muscle strengthening (*dhatu-pushti*). These medicines support *dhatu* (tissue) replenishment (mamsa) and counteract wasting (*kshaya*).
- *Panchakarma* Regimen: Typically, a course begins with *Snehapana* (internal oleation) followed by *Swedana* and *Basti* as detailed. Specific protocols may be tailored: e.g. in acute pain, *shirodhara* (oil dripping) or mild *nasya* might be emphasized, while in chronic stiffness a longer course of *basti* and *Rasayana* is used.

Clinical reports suggest this multi-modal *Ayurvedic* regimen can improve pain, mobility and function, potentially reducing reliance on steroids[11][7]. However, high-quality trials are limited; thus these treatments are best integrated with conventional rehab under supervision.

Integrative Rehabilitation Model

We propose a stage-wise integrative model combining therapies from both systems (see Table 1). In the Acute Phase, modern care focuses on pain control (NSAIDs, rest) and gentle ROM exercises, while *Ayurveda* contributes *Vata*-pacifying measures (warm oil massage, light fomentation). For example, a patient may receive simultaneous *Abhyanga* and pendulum exercises, accelerating pain reduction and beginning mobilization. In the Subacute Phase, emphasis shifts to controlled strengthening (theraband exercises, scapular stabilization) combined with *Ayurvedic basti* and continued *snehana* to deepen tissue healing. Finally in the

Recovery Phase, advanced strengthening and functional drills are augmented by *rasayana* herbs to rebuild tendon-muscle integrity. This complementary strategy aims to address both biomechanical deficits and systemic imbalances.

Table 1 : Integrative rehabilitation pathway combining modern and Ayurvedic interventions at each phase.

Rehabilitation Phase	Modern Orthopedic & Physiotherapy Approach	Ayurvedic Management	Therapeutic Goals
Acute Phase (0–6 Weeks)	Activity modification, NSAIDs, cryotherapy, pendulum exercises, passive ROM exercises, scapular setting exercises	*Abhyanga with Mahanarayana Taila/Ksheerabala Taila, mild Swedana, Pratimarsha Nasya with Anu Taila*	Pain reduction, inflammation control, prevention of stiffness, maintenance of mobility
Subacute Phase (6–12 Weeks)	Active ROM exercises, isometric rotator cuff strengthening, theraband resistance exercises, scapular stabilization, postural correction	*Patra Pottali Sweda, Matra Basti/Ksheera Basti, Rasnasaptakam Kashayam, Yogaraja Guggulu, continued Snehana*	Restoration of ROM, tendon healing, muscle strengthening, Vata shamana
Recovery Phase (>12 Weeks)	Progressive resistance training, dumbbell strengthening, proprioceptive exercises, closed-chain rehabilitation, sport-specific functional training	*Rasayana therapy, Bala/Ashwagandha preparations, yoga-based rehabilitation, maintenance Basti*	Functional recovery, restoration of biomechanics, endurance improvement, prevention of recurrence
Maintenance & Prevention Phase	Home exercise program, ergonomic correction, flexibility exercises, scapular stabilization drills	*Dinacharya, Vatahara Ahara, regular Abhyanga, lifestyle modification, Rasayana support*	Long-term shoulder stability, prevention of reinjury, maintenance of function

PROPOSED INTEGRATIVE PROTOCOL

Based on the above, a clinician might implement the following protocol:

1. **Acute Stage:** Prescribe NSAIDs as needed; initiate pendulum and scapular setting exercises. Start *Abhyanga* with *Mahanarayana Taila* daily and gentle *Swedana* (e.g. steamed poultice). Perform *Nasya* with *Anu Taila*. Continue analgesics or injections only if severe pain persists.

2. **Subacute Stage:** Progress to active-assisted ROM and isometric rotator cuff exercises; add elastic-resistance strengthening for deltoid and scapular stabilizers. Begin *Matra Basti* with *Bala* or *Shatavari* decoction, weekly for 4–6 sittings. Shift internal medicine to *Rasnasaptakam* or *Maharasnadi kvatham* (twice daily). Educate patient on posture, home exercise adherence.

3. **Recovery Stage:** Advance to isotonic and functional exercises (weighted shoulder presses, rowing, pulleys). Introduce yoga asanas (e.g. *Bhujangasana, Setubandhasana*) for scapular mobility. Continue one dose of *Yapana Basti* if tolerated for nourishment. Maintain herbal *Rasayana (Guggulu)* for 2–3 months to rebuild tissues. Focus on gradual return to full activities.

Throughout, monitor pain, range and function (e.g. SPADI score) to guide progress. Any worsening (e.g. increasing weakness) warrants re-evaluation for imaging or specialist referral. The integrative approach is iteratively tailored to patient response and tolerability.

SAFETY AND CONTRAINDICATIONS

Integrative therapy is generally safe when appropriately administered. Exercise prescriptions should avoid painful maneuvers; acute inflammation, infection or recent surgery are temporary contraindications to aggressive physiotherapy or injections. Corticosteroids are avoided in uncontrolled diabetes or infection. *Ayurvedic* procedures require experienced practitioners: *Agnikarma* must be done with care to avoid burns; *basti* therapies are contraindicated in active haemorrhoids or GI ulcers; and *Nasya* is avoided if nasal passages are severely inflamed. Herbal medicines should be used with caution in pregnancy or known drug sensitivities. Patients on multiple NSAIDs or steroids should be monitored for gastrointestinal or tendon side effects. In all cases, therapy is individualized and precautions are taken to minimise adverse effects.

RESEARCH GAPS AND FUTURE DIRECTIONS

High-quality clinical trials on integrative management of RC injuries are scarce. Most *Ayurvedic* recommendations derive from classical texts or case reports. Evidence suggests *Ayurvedic* therapies (*snehana, swedana, basti*) can alleviate pain and stiffness[11], but rigorous RCTs comparing *Ayurveda* with or without standard physiotherapy are needed. Future research should standardize interventions (e.g. dose/regimen of *Nasya or Basti*) and use validated outcomes. Comparative studies could evaluate whether adding *Ayurvedic* modalities to a conventional rehab program yields superior or faster recovery. Moreover, objective biomechanical assessments (e.g. MRI tendon healing) would clarify any structural benefits of internal medicines. Greater collaboration between orthopaedic clinicians and *Ayurveda* researchers is warranted to fill these gaps and refine evidence-based protocols.

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