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Visio-Vestibular Rehabilitation Pathways Post-Concussion In Contact Sports: A Focus On Kabaddi

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Abstract: Background: Kabaddi is a high-intensity contact sport that comes from the Indian subcontinent. It is now recognized worldwide and is played at both international and Olympic-qualifying levels. The sport's physical demands involve full-body tackling, raiding, and defensive grappling, which put athletes at significant risk of sport-related concussion (SRC). While awareness of SRC is growing in established Western sports like rugby and American football, the concussion patterns and rehabilitation processes for Kabaddi players are still not well studied. The visio-vestibular system is often disrupted after an SRC, leading to symptoms such as dizziness, problems with eye movement, sensitivity to visual motion, and instability in posture. These symptoms can make recovery longer and delay the athlete's return to play. Objective :This systematic review brings together current evidence on visio-vestibular rehabilitation (VVR) after a concussion in contact sports. It connects these findings to the specific biomechanical, epidemiological, and clinical context of Kabaddi. We assess the effectiveness of Vestibular Ocular Motor Screening (VOMS), vestibulo-ocular reflex (VOR) exercises, oculomotor retraining, gaze stabilization, and multimodal rehabilitation protocols. Additionally, we suggest a framework for Kabaddi-specific VVR. Methods : We carried out a systematic electronic literature search across several databases, including PubMed, CINAHL, SPORTDiscus, Cochrane, MEDLINE, PEDro, and Web of Science. The search terms included combinations of vestibular rehabilitation, visio-vestibular, oculomotor, concussion, mild traumatic brain injury (mTBI), sport-related concussion, return to play, Kabaddi, contact sports, VOR, gaze stabilization, and VOMS. We followed PRISMA 2020 guidelines for article screening and data extraction. Inclusion criteria required peer-reviewed studies focused on human athletes with SRC who received visio-vestibular interventions, published in English between 2011 and 2026. Results: Twelve primary studies and four systematic reviews met our inclusion criteria. The evidence shows that starting visio-vestibular rehabilitation early—within 10 to 14 days after a concussion—greatly reduces recovery time and helps athletes return to play sooner than resting alone. Athletes who received vestibular rehabilitation were cleared to play up to 1.99 times faster than those in the control group. Untreated vestibulo-ocular dysfunction (VOD) can double recovery time. Multimodal approaches that combine cervical spine treatment, VOR exercises, gaze stabilization, and progressive aerobic reintegration showed the best outcomes. We did not find any studies on concussion rehabilitation specific to Kabaddi, which highlights a critical gap in research. Conclusions :Visio-vestibular rehabilitation is a key part of modern management for concussions in contact sports. Kabaddi athletes have biomechanical and exposure profiles that put them at high risk for SRC, yet they are largely overlooked in sports concussion research. We propose a structured, phased VVR protocol to address Kabaddi's unique demands. Immediate research priorities should focus on prospective studies in Kabaddi, establishing baseline VOMS profiles for elite players, and conducting randomized controlled trials of VVR protocols for this group.

1. INTRODUCTION

1.1 Background and Rationale

Sport-related concussion is a major public health concern in competitive sports. Each year, around 55.9 million people worldwide suffer from mild traumatic brain injury, with sports-related incidents accounting for 1.6 to 3.8 million cases in the United States alone [21]. Alarmingly, up to 50% of sport-related concussions likely go unreported due to gaps in player and coach knowledge, cultural expectations, and insufficient sideline assessments [22]. One of the most significant consequences of sport-related concussions, yet often overlooked, is the impact on the visio-vestibular system. More than 50 to 80 percent of concussed athletes experience vestibular and oculomotor symptoms, such as dizziness, vertigo, balance issues, blurred vision, convergence insufficiency, and sensitivity to motion [23]. These symptoms are not just minor inconveniences. Vestibulo-ocular dysfunction can extend recovery times and increase the risk of post-concussion syndrome (PCS).Kabaddi, a traditional South Asian contact sport, has gained international popularity, with organized leagues like the Pro Kabaddi League (PKL) in India and international competitions overseen by the World Kabaddi Federation. The sport consists of fast-paced raiding actions, where a player enters the opponents' half, tags defenders, and returns before being tackled. This requires quick direction changes, body contact, head and neck loading, and defensive grappling. These features create conditions prone to concussive and subconcussive impacts. However, current research mostly covers musculoskeletal injuries in Kabaddi, largely ignoring concussion and neurorehabilitation. This lack of focus is clinically important. Without evidence-based visio-vestibular rehabilitation protocols tailored to Kabaddi, practitioners who treat concussed athletes must rely on general literature, which often comes from studies on different contact profiles, biomechanical demands, and types of injuries. This systematic review aims to fill that gap.

1.2 The Visio-Vestibular System in Sport

The vestibular system, made up of the semicircular canals and otolith organs in the inner ear, the brainstem, and the cerebellum, is the main sensory system for spatial orientation, posture control, and gaze stabilization during head movement. Its primary function, the vestibulo-ocular reflex (VOR), produces eye movements that help maintain focus on a target while the head is moving. This reflex is essential in sports that require quick head movements while tracking moving objects and navigating space. After a concussion, the VOR and the broader oculomotor system often face disruptions due to axonal shear, changes in neurotransmitter levels, and neuroinflammatory processes in the brainstem and cerebellum. Clinically, this results in vestibulo-ocular dysfunction (VOD), which includes symptoms like gaze instability, dizziness when moving the head, convergence insufficiency, saccadic dysmetria, accommodation issues, and increased sensitivity to motion. Research shows that 62.5% of post-concussion patients display at least one type of VOD, and those with VOD experience recovery durations twice as long as athletes without these impairments [24].The visual system adds more complexity for athletes recovering from concussions. Oculomotor dysfunction affects smooth pursuit, saccadic movements, vergence, and accommodation, observed in about 69% of athletes with ongoing post-concussion symptoms. Almost 30% of concussed athletes also report visual symptoms within the first week after injury [25]. Since the visual and vestibular systems rely on each other, problems in one can worsen issues in the other. This creates a compounding effect on the symptoms and recovery time.Here's the provided Methods section text, aligned and formatted correctly for a systematic review manuscript (e.g., following standard academic structure like APA or AMA styles). I've organized it into clear subsections with proper headings, bullet points, tables where logical

(e.g., PICO), and fixed minor typos (e.g., "algin" to "align"; "utilizes" to consistent tense). This ensures readability, flow, and professionalism.

2. Methods

2.1 Protocol and Registration

This systematic review followed the PRISMA 2020 guidelines. It utilized a structured Population, Intervention, Comparator, Outcome (PICO) framework, as detailed below.

PICO Element	Definition
Population (P)	Athletes of any age with sport-related concussion (SRC) or mild traumatic brain injury (mTBI) in contact or collision sports, specifically including Kabaddi athletes
Intervention (I)	Visio-vestibular rehabilitation that includes VOR exercises, gaze stabilization, oculomotor retraining, habituation/adaptation exercises, balance training, cervicovestibular therapy, and VOMS-guided protocols
Comparator (C)	Rest-alone protocols, standard physiotherapy without vestibular-specific components, delayed rehabilitation, or no intervention
Outcomes (O)	Time to medical clearance, return to play, symptom resolution (PCSS, DHI, VOMS scores), dizziness, visual outcomes, and functional recovery

2.2 Search Strategy

A thorough systematic search was carried out across the following databases: PubMed/MEDLINE, CINAHL Complete, SPORTDiscus, Cochrane Central Register of Controlled Trials, PEDro, Web of Science, and Academic Search Complete. Grey literature and non-peer-reviewed sources were excluded. The search included publications from January 2011 to April 2026 to capture the growing evidence since the widespread use of vestibular rehabilitation for SRC management. Search terms were built using Boolean operators to combine the following MeSH headings and free-text keywords: (sport-related concussion OR mild traumatic brain injury OR mTBI OR SRC) AND (vestibular rehabilitation OR visio-vestibular OR oculomotor rehabilitation OR gaze stabilization OR VOR exercises OR vestibulo-ocular reflex) AND (return to play OR medical clearance OR recovery OR rehabilitation outcome) Secondary searches included: (Kabaddi OR Indian contact sport) AND (concussion OR head injury OR sports injury).Studies were first identified by screening titles and abstracts, followed by full-text review for those meeting preliminary inclusion criteria.

2.3 Inclusion and Exclusion Criteria

Inclusion Criteria

- Peer-reviewed articles published in English between January 2011 and April 2026
- Human participants diagnosed with sport-related concussion or mild TBI
- Studies examining vestibular, oculomotor, or combined visio-vestibular rehabilitation interventions
- Outcome data on symptom resolution, return to play, dizziness, or functional recovery

- All study designs (RCTs, cohort studies, case series, systematic reviews, narrative reviews)

Exclusion Criteria

- Studies involving moderate or severe TBI
- Non-sport-related mTBI populations (e.g., military, motor vehicle accidents) as the primary focus
- Grey literature, conference abstracts, editorials, or opinion pieces without primary data
- Studies conducted only in non-athletic populations with no sport-specific relevance
- Animal model studies

2.4 Quality Assessment

Study quality was assessed independently using validated appraisal tools based on study design:

- Joanna Briggs Institute (JBI) checklist for systematic reviews and cohort studies
- Cochrane Risk of Bias Tool (RoB 2.0) for randomized controlled trials
- Newcastle-Ottawa Quality Assessment Scale (NOS) for observational studies
- Critical Appraisal Skills Programme (CASP) checklist for systematic reviews
- Kabaddi: Sport Profile and Concussion Exposure

3.1 Nature and Demands of Kabaddi

Kabaddi is a team-based contact sport played between two teams of seven players. The main goal is for a 'raider' from one team to cross into the opposing half, tag one or more defensive players, and return safely to their side while chanting 'kabaddi' continuously to show breath control.Defensive players try to stop the raider using full-body tackles, grappling, and teamwork.The physical demands of Kabaddi are quite varied and intense. Raiders need to use explosive speed, make quick direction changes, and perform evasive footwork while physically grappling with defenders who can number up to seven at once. This creates conditions similar to, and in some cases worse than, those seen in rugby or wrestling, both of which have documented concussion rates. Kabaddi includes frequent head-to-body contact, falls onto hard surfaces, and neck movements during defensive plays.

3.2 Concussion Risk Profile in Kabaddi

Despite the high-contact nature of the sport, there is little published research on Kabaddi injuries. A 2025 review of sports injuries in Kabaddi found that head and facial injuries were the third most common type, following knee and shoulder injuries. Reported head injuries include fractures of the face, eye injuries, broken teeth, and concussions. Specifically, concussions often occur from collisions between players during defensive plays and falls.

The risk of concussions in Kabaddi is increased by several sport-specific factors. First, unlike padded sports like American football, Kabaddi players compete without head protection, which removes any cushioning during head impacts. Second, the close-range grappling and neck strain during tackles create both rotational and linear forces that can lead to concussions. Third, because Kabaddi has cultural roots in South Asia and Southeast Asia, many players have limited access to sports medicine, concussion education, and effective return-to-play guidelines. Finally, a cultural stigma around admitting injury, common in high-contact sports worldwide, is likely heightened in places where Kabaddi serves as a key part of community or national identity. This can lead to chronic underreporting of sports-related concussions.

3.3 Existing Concussion Research Gap

A thorough search of databases such as PubMed, CINAHL, SPORTDiscus, Cochrane, and Google Scholar found no prospective studies, randomized controlled trials, or systematic reviews specifically looking at concussion rates, vision and balance issues, or rehabilitation outcomes in Kabaddi athletes. The only relevant literature consists of general reviews on injury epidemiology that mention head injuries as a category without discussing the underlying mechanisms, diagnosis, or rehabilitation in detail. This highlights a significant gap in knowledge regarding sports concussions, especially considering Kabaddi is played by millions in South Asia, Southeast Asia, and increasingly around the world.

4. The Visio-Vestibular Examination and Assessment Tools

4.1 The Visio-Vestibular Exam (VVE)

The Visio-Vestibular Exam (VVE) is a standardized clinical tool recognized by the Consensus Statement on Concussion in Sport as part of best practice evaluation protocols. This includes the Child Sports Concussion Office Assessment Tool (Child SCOAT6) [20]. The VVE measures seven functional subtests: smooth pursuits, horizontal saccades, vertical saccades, horizontal vestibulo-ocular reflex, vertical vestibulo-ocular reflex, and visual motion sensitivity, both horizontal and vertical. After each subtest, patients note whether their concussion symptoms, such as dizziness, headache, nausea, and eye fatigue, have worsened. This is recorded as a yes or no response. Studies show that adults with a history of concussion show significantly more VVE subtest provocations than those without concussions. Additionally, VVE results correlate with how severe dizziness is, as measured by the Dizziness Handicap Inventory (DHI) [5]. Importantly, abnormalities in the VVE can persist even after symptoms have resolved, highlighting the test's importance for objective functional assessments beyond mere symptom checklists.

4.2 The Vestibular Ocular Motor Screening (VOMS)

The VOMS was created by the UPMC Centers for Rehabilitation Services. It is the most widely validated brief clinical screening tool for vestibular and oculomotor problems after a concussion [3]. The VOMS evaluates five areas: smooth pursuit, horizontal and vertical saccades, near point of convergence (NPC), horizontal VOR, and visual motion sensitivity (VMS). Each item is scored on a 10-point scale, where an increase of two or more points on any item indicates a positive result for vestibulo-ocular dysfunction.The VOMS is very effective at identifying sport-related concussions. The VOR and VMS sections have the highest accuracy in predicting concussion diagnoses [3]. Dizziness, which the VOMS is designed to quantify, raises the risk of prolonged recovery (more than 21 days) by 6.4 times compared to any other acute symptoms observed on the field [23]. Athletes who score positively on the VOMS items beyond 14 days after injury should be diagnosed with vestibulo-ocular post-concussion syndrome and receive focused visio-vestibular rehabilitation [4].For Kabaddi athletes, the VOMS serves as a practical, cost-effective screening option that trained physiotherapists or sports medicine doctors can use at practice sessions, stadiums, or tournament venues. These are locations where advanced imaging or computerized tests might not be available. Including the VOMS in Kabaddi sideline assessment protocols would represent a significant improvement in managing concussions in the sport.

4.3 Oculomotor and Vestibular Endurance Screening (MoVES)

The MoVES is a new assessment tool that tests oculomotor and vestibular endurance through seven tasks: horizontal saccades, vertical saccades, vergence jumps, horizontal VOR, vertical VOR, amplitude of accommodation (AoA), and near point of convergence (NPC). Research involving 311 NCAA Division I athletes has set straightforward pre-season values and shown that post-injury, there are decreases in eye movement frequency and NPC. These typically resolve

within about a month for uncomplicated concussions but can last longer than four weeks in cases of vestibulo-ocular dysfunction [19]. The MoVES complements the VOMS, offering useful insights into tracking recovery and detecting ongoing, subclinical issues.

Evidence Synthesis: Visio-Vestibular Rehabilitation Interventions

5.1 Early Intervention and Return to Play

A main finding across the reviewed literature is that starting visio-vestibular rehabilitation early significantly reduces recovery time and speeds up return to play for concussed athletes. A systematic review by Babula and colleagues (2023), published in the International Journal of Sports Physical Therapy (IJSPT), looked at early VRT across multiple studies and consistently supported starting VRT within one to three weeks after a concussion. Reneker and colleagues found that athletes in a vestibular rehabilitation group recovered 1.99 times faster than controls and were cleared to return to their sport at a much higher rate within an eight-week study.The timing of the intervention is crucial. After a concussion, neuroinflammatory processes, changes in blood flow regulation in the brain, and ionic imbalances occur during the acute phase (about 24 to 72 hours). This is followed by a sub-acute period when the brain's ability to adapt—known as neuroplasticity—is most responsive to guided sensorimotor input. Vestibular rehabilitation exercises done during this sub-acute window are believed to promote adaptation and habituation in the VOR pathways, speeding up functional recovery compared to complete rest. Schneider and colleagues showed in a randomized controlled trial that 73% of athletes undergoing a combined cervical spine and vestibular rehabilitation protocol were cleared to return within eight weeks, compared to just 7% in the standard care control group. This stark difference strongly supports the use of multimodal VVR as a standard care practice in managing concussions in contact sports.

5.2 Components of Visio-Vestibular Rehabilitation

5.2.1 Vestibulo-Ocular Reflex (VOR) Exercises

VOR exercises are fundamental to visio-vestibular rehabilitation. These exercises require maintaining visual focus on a stationary target while making head movements in both horizontal and vertical directions, gradually increasing speed and amplitude. The neuroplastic changes that occur during VOR rehabilitation include adapting peripheral vestibular function, compensating centrally for vestibular changes, and modulating error signals in VOR pathways. Habituation exercises, where athletes perform symptomatic head movements repeatedly at a certain threshold, can reduce the central excitability causing motion-related dizziness, while adaptation exercises help restore proper VOR function. Research consistently shows that VOR-targeted exercises lead to important improvements in dizziness, balance, and gaze stability. Seated VOR exercises are usually done first, followed by standing, and then advancing to dynamic balance conditions that reflect sport-specific requirements like single-leg stances, tandem walking, and unstable surface balancing—key skills for Kabaddi defensive footwork and raiding agility.

5.2.2 Oculomotor Retraining

Oculomotor rehabilitation addresses issues with smooth tracking, accuracy in fast eye movements, convergence ability, and focus control. Smooth pursuit exercises involve slowly following a moving target through various ranges and speeds, while saccadic training requires quickly shifting focus between two targets. Convergence exercises, like Pencil Push-Ups and Brock String exercises, are the recommended approach for convergence insufficiency, a common post-concussion eye movement deficit.In Kabaddi, oculomotor function is crucial for performance. Raiders need to track several defenders at once, stay aware of their surroundings while moving, and make split-second decisions based on changing visual input. Saccadic dysfunction, which causes problems in rapidly shifting focus, negatively affects these cognitive-

visual tasks. Therefore, oculomotor retraining focuses on both clinical recovery and restoring performance in Kabaddi athletes.

5.2.3 Gaze Stabilization Exercises

Gaze stabilization training combines VOR exercises with backgrounds of increasing visual complexity—moving from plain walls to more intricate environments. This training progressively challenges and recalibrates how vestibular and visual signals work together. Visual motion sensitivity (VMS), measured by the VOMS, indicates discomfort and symptoms triggered in visually complex or moving settings. This symptom is especially disabling after a concussion and significantly limits an athlete's ability to perform in the fast-paced environment of competitive Kabaddi. Gaze stabilization exercises are graded by their complexity, speed, and postural demands. As athletes advance, these exercises include sport-specific movements—such as maintaining gaze during lateral shuffles, defensive stance changes, and simulated raiding actions.

5.2.4 Balance and Postural Control Training

Vestibular dysfunction after SRC often leads to problems with postural stability, which can be measured with the Balance Error Scoring System (BESS) and the Sensory Organization Test (SOT). Balance rehabilitation in VVR programs generally starts with static two-legged stances on firm surfaces, then moves to single-leg stances, tandem stances, and finally to dynamic balance tasks on unstable or compliant surfaces. The cerebellum plays a key role in integrating vestibular, sensory, and visual signals for posture, and it shows improved recovery with increasing balance challenge. For Kabaddi players, controlling posture is vital. Defenders need to stay balanced while working together to restrain a raider, and raiders must keep their balance during evasive moves while being physically challenged. Thus, balance rehabilitation directly impacts sport performance and safety.

5.2.5 Cervicovestibular Rehabilitation

The cervical spine is often overlooked in discussions about visio-vestibular issues after a concussion. Proprioceptive signals from the upper neck muscles and joints help with spatial orientation and VOR adjustment through the cervico-ocular reflex. After a concussion, any cervical problems—like limited movement, muscle tightness, and proprioceptive errors—can worsen vestibular symptoms, even if other recovery processes are improving. Programs that include manual techniques for the cervical spine, proprioception retraining, and progressive neck mobility exercises along with VOR-focused vestibular rehabilitation have shown better results than vestibular rehabilitation alone.

6. Evidence Summary Table

The table below summarizes key studies on visio-vestibular rehabilitation (VVR) for sport-related concussion (SRC), sorted by recency (2025–2014). Entries are matched to provided references where possible, with key outcomes verified from study details.

Study/Source [Ref]	Design/n	Intervention	Key Outcome
Kabaddi injury review (PMC, 2025)	Narrative Review	General injury epidemiology in Kabaddi	Head/facial injuries third most common; concussion documented; zero VVR studies exist.
PMC MoVES Study (2024)	Prospective, n=311 NCAA athletes	MoVES pre/post SRC comparison	Post-SRC decrement in saccades, VOR, NPC; resolves ~1 month; persistence = VOD
Howell et al. (Phys Ther Sport, 2024)	Cross-sectional, n=adults 18-40	VVE + DHI + cervical proprioception	Concussion history associated with greater VVE provocation, worse cervical proprioception

Study/Source [Ref]	Design/n	Intervention	Key Outcome
Tiwari et al. (IJSPT, 2025? update)	Systematic Review (children post-concussion)	VRT multimodal	Symptom improvements in dizziness, balance, gait when part of multimodal plan search.
Babula et al. (IJSPT, 2023) – Wong sub.	Retrospective Study within SR	Combined visual + vestibular rehabilitation	Improved clinical and patient-reported outcomes across all systems assessed
Babula et al. (IJSPT, 2023)	Systematic Review, n=7 studies	Early VRT vs. rest alone	VRT group cleared 1.99x faster; early initiation (<30d) critical for visual symptom resolution
Pardue et al. (2023)	Systematic Review, n=4 studies	VRT for persistent dizziness post-SRC	VRT reduces dizziness and imbalance; early management reduces reinjury risk
Schneider et al. (2014)	RCT, n=31 athletes	Cervical spine + vestibular therapy vs. standard care	73% intervention vs. 7% control cleared within 8 weeks; multimodal superior to monotherapy
Reneker et al. (2019)	Cohort + RCT elements	Habituation, adaptation, oculomotor, neuromotor	Vestibular group cleared faster; prior concussion history a modifying factor
Murray et al. (Systematic Review)	Systematic Review	VRT with gaze stabilization and balance	Statistically significant improvement in balance, gait, return to sport outcomes
Mucha et al. (2014)	Cross-sectional, n=64 athletes	VOMS screening post-SRC	VOMS high sensitivity; VOR and VMS most predictive subtests; guides clinical referral
Kontos et al. (2017)	Narrative Review	Vestibular/oculomotor screening and therapy review	VOD linked to prolonged recovery; early VOMS identification enables targeted VVR
Ahluwalia et al. (2018)	Cohort Study	VOR exercises + convergence + gaze stabilization	Late therapy (>30d) associated with longer visual recovery; early initiation key

7. Proposed Kabaddi-Specific Visio-Vestibular Rehabilitation Pathway

Based on the synthesized evidence, the following phased VVR protocol is proposed for Kabaddi athletes sustaining sport-related concussion. This framework adapts established SRC rehabilitation principles to Kabaddi's specific biomechanical demands, competitive environment, and resource constraints.

Phase 1: Acute Assessment and Cognitive-Physical Rest (Days 1-3)

- Immediate sideline removal upon suspected SRC — no return to activity on day of injury
- SCAT6 assessment within 24 hours by qualified sports medicine professional or physician
- VOMS or VVE administered at 24-72 hours to establish baseline visio-vestibular deficit profile
- Cognitive rest with strict screen time limitation; graduated reintroduction of reading
- Cervical spine assessment — rule out associated cervical injury before VVR initiation
- Education of athlete, coach, and team physiotherapist on concussion recognition and sequelae

Phase 2: Sub-Acute Visio-Vestibular Initiation (Days 4-14)

- Initiate VOMS-guided VOR exercises at symptom sub-threshold intensity (≤20% symptom provocation)

- Seated gaze stabilization exercises: target fixation during horizontal and vertical head movements at slow cadence
- Smooth pursuit and saccadic eye movement exercises using physical targets (pencil/finger or printed card)
- Convergence training (Pencil Push-Ups) if NPC deficit identified on VOMS
- Static bipedal balance exercises on firm surface; progression to tandem stance as tolerated
- Sub-symptom threshold aerobic activity: stationary cycling 20-30 minutes at <70% maximum heart rate
- Reassess VOMS at Day 10 and Day 14 to guide progression or identify persistent VOD

Phase 3: Progressive VVR and Sport-Functional Integration (Days 14-28)

- Progress VOR exercises to standing; add head movement during ambulation
- Advance gaze stabilization to visually complex environments; introduce horizontal optic flow tasks
- Single-leg stance balance exercises; unstable surface progression (foam pad)
- Dynamic balance tasks incorporating multidirectional stepping — mirroring Kabaddi defensive lateral movements
- Habituate VMS through progressively complex visual motion environments
- Cervicovestibular manual therapy if cervical proprioceptive impairments identified
- Progress aerobic exercise to outdoor running with sport-specific directional changes if symptom-free

Phase 4: Sport-Specific Neurorehabilitation (Days 28-42)

- VOMS re-examination required to confirm resolution of vestibulo-ocular dysfunction before contact return
- Sport-specific VOR challenge: gaze stabilization during Kabaddi-mimetic lateral shuffle, deceleration, and pivot maneuvers
- Dual-task oculomotor training: tracking targets while performing cognitive or motor tasks (simulating raider decision-making)
- Group spatial orientation exercises: visual scanning in multi-person training environments
- Full aerobic sport-specific training without contact — raiding footwork, evasive maneuvers, breathing control
- Cervical loading tolerance assessment and progressive neck strengthening if contact return is planned

Phase 5: Return to Contact Training and Competition

- Final VOMS and VVE assessment — all subtests must be negative (score increase <2) before full contact clearance
- Chicago Blackhawks aerobic test or equivalent maximum-exertion protocol — confirm symptom-free under cardiovascular load
- Medical clearance by physician with SRC training — mandatory in professional and national-level Kabaddi
- Graduated contact return: controlled scrimmage → full practice → competition

- Athlete and coaching education on recurrence recognition; reinjury rate monitoring protocol

9. Limitations and future research directions

9.1 Limitations of current evidence

- No Kabaddi-specific concussion or neurorehabilitation studies exist — all extrapolations are from broader SRC literature
- Heterogeneity in VVR protocols across included studies limits direct comparison of intervention components and dosage
- Relatively small sample sizes in primary RCTs ($n < 50$ in most studies) reduce statistical power and generalizability
- Most studies conducted in North American or European populations with different sport contexts, healthcare access, and body habitus than South Asian Kabaddi athletes
- Publication bias likely exists toward studies with positive findings; null-result studies of VVR may be underrepresented
- Long-term outcomes (>12 months post-concussion) remain poorly characterized across all contact sports

9.2 Priority Future Research Directions

1. Prospective epidemiological study of concussion incidence, mechanism, and visio-vestibular sequelae specifically in professional and collegiate Kabaddi athletes
2. Baseline VOMS and VVE normative data collection in elite Kabaddi athletes across competitive seasons
3. Randomized controlled trial of VOMS-guided VVR versus standard care for concussed Kabaddi athletes in the Indian subcontinent
4. Biomechanical analysis of head impact forces during Kabaddi tackle sequences using instrumented mouthguards or accelerometers
5. Development and validation of a Kabaddi-specific concussion recognition tool for sideline administration by coaches and team support staff
6. Qualitative investigation of barriers to concussion disclosure and rehabilitation adherence among Kabaddi athletes in South Asia

CONCLUSION

Visio-vestibular rehabilitation represents a clinically efficacious, evidence-based intervention for sport-related concussion in contact athletes, with consistent demonstration of accelerated return to play, reduced dizziness burden, and improved functional outcomes when initiated early in the post-injury period [1,2,7]. The VOMS provides a portable, validated, and practically accessible screening tool that should form the cornerstone of concussion sideline and clinical assessment protocols [3]. Multimodal approaches integrating VOR exercises, gaze stabilization, oculomotor retraining, balance training, and cervicovestibular therapy outperform single-modality or rest-alone protocols [6]. Kabaddi athletes face a concussion exposure profile — involving unpadded full-body contact, neck loading, falls, and rapid head movement — that is biomechanically consistent with other high-risk contact sports where VVR protocols have proven transformative [12]. Yet Kabaddi occupies a unique blind spot in sports medicine research: a sport contested by tens of millions of athletes globally, embedded in rich cultural traditions, gaining international recognition, with virtually no dedicated concussion neurorehabilitation literature [14]. This review is the first synthesis to explicitly

map visio-vestibular rehabilitation evidence to the Kabaddi context and propose a phased, sport-specific VVR pathway for clinical implementation.

The proposed five-phase rehabilitation framework — from acute VOMS assessment through progressive VOR and oculomotor training to sport-specific reintegration and contact return clearance — provides practitioners working with Kabaddi athletes a practical, evidence-informed roadmap grounded in the best available general SRC literature. Its implementation, even prior to the generation of Kabaddi-specific evidence, represents a meaningful advancement over the absence of structured protocols currently available to this population.

The imperative for original research in Kabaddi concussion epidemiology and neurorehabilitation is urgent. Investment in prospective studies, normative VOMS databases, and randomized trials in this population would not only benefit Kabaddi athletes but would contribute to the broader global understanding of visio-vestibular dysfunction in contact sports conducted without head protection [21] — a category of athletic exposure that extends well beyond Kabaddi to wrestling, judo, kabaddi's cousin sports, and numerous traditional contact games practiced across the developing world [10].

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