Protocol based management of common sports injuries by integrated approach of Sandhi Marmabhighata - An open labeled clinical trial

Sudhanshu Sharma a, Ramesh Killedar a, *, Deepti Bagewadi b, Pradeep Shindhe a

a Department of Shalyatantra, KAHER’s Shri B. M. Kankanawadi Ayurveda Mahavidyalaya, Shahapur, Belagavi, Karnataka, India
b Department of Physiotherapy, KAHER’s Shri B. M. Kankanawadi Ayurveda Mahavidyalaya, Shahapur, Belagavi, Karnataka, India

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A B S T R A C T

Background: Sports injuries are the second most common type of accident after domestic (3.7%) and occupational accidents (3.1%). There is an average annual estimate of 8.6 million sports and recreational related injury incidents with an age-adjusted rate of 34.1 per 1000 populations. Common sports injuries are musculoskeletal injuries i.e. Sprains, Strains, Joint injuries, soft tissue injury (STI). The sports injury in Ayurveda can be co-related within dissimilar facets of trauma related ailments.

Objective: To evaluate the efficacy of a protocol-based management of common sports injuries using an integrated approach.

Materials and methods: Integration of Ayurveda and Physiotherapy procedures was done and phase wise treatment was framed. Total 30 patients of age between 10 and 60 years ful-filling the inclusion criteria were selected for the present study. The patients were treated with Phase wise protocol consisting of three phase’s i.e. Inflammatory (1–5 days), Stabilization and recovery (6–10 days), Muscle strengthening (11–17 days). Assessments were done through various variables like pain, tenderness, swelling, local temperature, manual muscle testing (MMT) and range of motion (ROM) at different time points.

Statistical analysis: Wilcoxon matched pair test was used to assess within group results for subjective parameters and paired t-test (Dependent t-test) was used to assess for objective parameters.

Result: The study showed that integrated treatment approach has given significant results in the parameters like pain, loss of function, tenderness, local temperature, MMT and ROM.

Conclusion: Phase wise management through integrated protocol is effective in the management of common sports injuries.

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1. Introduction

Sports and exercise medicine is defined as that discipline which treats any kind of injury, pain or physical damage that occurs as a result of sport, exercise or physical activity [1,4]. As the sports buzz is rising in these days, sports injuries are inclining especially in the areas of the joints like the ankle, elbow, wrist, knee etc. [5]. Soccer (30.6%), and kabaddi (20.9%) were the sports causing knee joint injuries, among cricketers 16.8% suffered upper limb injuries [3,13]. Individuals between 5 and 24 years of age accounted for more than 50% of all injury incidents [2].

As per Ayurveda, sports injuries are a kind of traumatic diathesis in which Vataidosha (bodily humors) are provoked that may lead to pain and others symptoms at the site of affliction [6]. The etiology, sign and symptoms of Sadyo-Vrana (Trauma), Bhagna (Fractures) and Marmabhighata (soft tissue injuries) when they are collectively analysed, they can be correlated to sports injuries [7]. Ayurveda classics have emphasized rehabilitation of injured person in case of Bhagna, Vrana and Marmaghata and highlighted individualised treatment approach based on Dosha for a better outcome [6,7]. Conventional approaches to sports injuries include PRICER (Protection, Rest, Ice, Compression, Elevation and Rehabilitation) protocol, anti-inflammatory drugs, analgesics, immobilization, corticosteroid injections, physiotherapy and surgery [8]. Prolong usage of analgesics have high incidence of intolerable gastrointestinal side effects and other systemic side effects [9].

The treatment principle of marmabhigata includes both internal and external remedies like lepa (medicated paste) application, bandhana (Bandaging), pichu (oil cotton Swab) and various Panchakarma (Five treatment procedure) procedures like Abhyanga (massage), Snehana (oilation), Swedana (Fomentation therapy) etc.
The Integration of complementary and alternative medicine into the sport arena helps in prevention, treatment of sports injuries and increases sport men performances [10]. Effective management of sports injuries requires phase wise assessment of injuries and preparation of special protocol by incorporating various procedures of Ayurveda and physiotherapy for better outcome. Hence the present study was designed to evaluate the efficacy of protocol based management of common sports injuries by integrated approach.

2. Materials and methods

The patients attending outpatient and inpatient department of the institute were recruited for the study. The CONSORT [11] statement guidelines are followed for reporting the outcomes of the study.

2.1. Raw drugs and finished products

Procurement of raw drugs and preparation of Manjishtadi lepa churna, Bhadarakadi Chrita were done at KAHER GMP certified Ayurveda pharmacy. Shatatdhauta Chrita was procured from KAHER GMP certified Ayurveda pharmacy. Authentication of raw drugs and analysis of finished product were done at AYUSH certified drug testing central research facility of our institute. Marma Gutika, Murrivenna taila and Balaarishta were procured from GMP certified Kerala Ayurveda pharmacy.

2.2. Subjects

Total 30 patients diagnosed with sports injuries were recruited from the OPD and IPD of the Shalya tantra Department, KLE Ayurveda Hospital, Shahapur, Belagavi.

2.3. Inclusion criteria

Diagnosed case of Common sports injuries within 7 days, either sex with age ranging from 10 to 60 years and complaining of pain, swelling, restricted joint movement were included in the study.

2.4. Exclusion criteria

Patients suffering with systemic diseases like diabetes mellitus, tuberculosis, malignant wounds, bleeding disorders; patients having a fracture with partial or complete displacement, deformity of joints. Pregnant and lactating females; patients with history of road traffic accidents with Medico legal cases were excluded.

Screening methods:

The recruited patients in the study were clinically examined and data were recorded systematically. X ray of particular joint was carried out at the Radiology department of our institute in order to rule out fracture and dislocations.

2.5. Research design

The study is a single group pretest-posttest quasi experimental clinical trial with a sample size of 30. The CONSORT Flow diagram of the study is provided in the Fig. 1.

2.6. Treatment protocol

The flow chart of the treatment protocol is provided in the Fig. 2.

2.7. Intervention

The duration of the intervention was 17 days; the informed consent was taken from the patients after orienting the nature
and design of the study. The study was approved by the Institutional Ethics Committee with Protocol Id BMK/17/PG/SL/5, Date of Approval 18.10.2019. CTRI Registration Number CTRI/2018/07/014910. Data collection was done since February 2018 to February 2019. During the study period, patients were asked to adhere the treatment protocol and report any adverse events to the investigators. Physiotherapy procedures were carried out under the instructions of qualified physiotherapist of our institute.

2.8. Criteria for assessment

2.8.1. Primary outcomes (Fig. 3)
Parameters like Pain (by Verbal descriptive scale), Tenderness (by modified Cipriano Scale), Swelling (graduation of length and breadth by using inch tape), Range of Motion of Joints (by Goniometry), Temperature (by infrared thermometer), Manual muscle testing grade (modified Cipriano scale) were assessed at different time points using standard operative procedures.

2.9. Statistical test

Statistical analysis was carried out using SPSS version 20.0. Comparison of different interventions from Base line to day 17 with respect to parameters like pain and tenderness were assessed by Wilcoxon matched pair test and the rest of the parameters were assessed by Paired t-test (Dependent t-Test). Values were reported as mean ± standard deviation and the parameters were considered statistically significant if the ‘p’ value is < 0.05.

3. Results

Study was completed with participation of total 30 patients without any reported adverse events and drop outs.

3.1. Subject characteristics

Age - 13% of the patients were from 10 to 20 yrs, 23% from 20 to 30 years, 20% from 30 to 40 years, 10% from 40 to 50 years, 34% from 50 to 60 years.
Sex - 60% of the patients were male and 40% were female in the present study.
Site of Injury - In the present study knee joint injuries were 33% (football, kabaddi, long jump, athletics), ankle injury 27% (volleyball, kabaddi, kho - kho), wrist injury 20% (table tennis, volleyball), and 10% each in elbow (cricket, badminton, table tennis), and shoulder joint injury (volleyball, basketball, kabaddi).
Type of sports involved - athletics (10%), badminton (6.66%), basketball (6.66%), cricket (10%), football (13.33%), kabaddi (16.66%), long jump (6.66%), table tennis (10%), volleyball (13.33%), kho kho (6.66%).

3.2. Primary outcome

Statistically significant results (p < 0.05) were seen in the parameters like pain, tenderness, swelling, local temperature, manual muscle test and range of motion of all major joints except shoulder, knee extension and elbow joint in all the three time points. Comparison of phase wise interventions showed significant improvement (p < 0.001) in the pain and tenderness parameters on 1–6th, 1–11th and 1–17th day. Significant improvement (p < 0.001) was seen in the parameters like swelling, local temperature and manual muscle test on three different time points i.e. 1–6th, 1–11th and 1–17th day. Significant improvement (p < 0.05) was seen in the range of motion, i.e. Overall joint extension [1–6th day (p = 0.003].
Rehabilitation of sports injuries includes four phases, i.e. immediate (control of pain and inflammation), intermediate (repair and regeneration of tissue and improve muscle performance), Advanced (muscle strengthening and restoring ROM) and return to play [12,13]. Evidence based practices are essential to forecast the efficacy of Ayurveda in managing sports injuries, to fulfil that objective framing of integrative protocol by incorporating Ayurveda and physiotherapy procedure as per phase wise was planned. Concept of rehabilitation in injured person is well highlighted by Ayurveda classics which include Lepa (paste) and Kusha (splint) application, Aanchana (traction), Pidana (manipulation), retention by Bandhana (bandaging), Kapata shayana (immobilisation by splint application with 5 nails), muscle strengthening exercises like holding of mudball, salt ball and stone ball in upper limb injury [6,7].

### 4. Discussion

**4.1. Immediate rehabilitation (control of pain and inflammation)**

Ayurveda classics explains the pathophysiology of acute injuries (Sadyo Varna) leading to vitiation of vata, rakta and ushna producing symptoms like pain, swelling, deformity and loss of function [14]. Management principles of marmaghata, sadyo vrana and bhagana are implemented in sports injury management, which advises cold paste (ML) application followed by bandaging etc immediately after

| Parameters         | Joint | Time periods | Mean change | SD changes | %of change | Z-value | p-value |
|--------------------|-------|--------------|-------------|------------|------------|---------|---------|
| Pain               | Ankle | Day 1–day 17 | 7.25        | 1.39       | 72.50      | 2.5208  | 0.0117* |
|                    | Knee  | Day 1–day 17 | 6.30        | 1.34       | 70.04      | 2.8031  | 0.0051* |
|                    | Shoulder | Day 1–day 17 | 4.67        | 1.15       | 58.33      | 1.6036  | 0.010*  |
|                    | Elbow | Day 1–day 17 | 5.33        | 1.15       | 61.54      | 1.6036  | 0.0108* |
| Loss of function   | Ankle | Day 1–day 17 | 1.63        | 0.52       | 86.67      | 2.5205  | 0.0117* |
|                    | Knee  | Day 1–day 17 | 1.50        | 0.71       | 93.75      | 2.6656  | 0.0077* |
|                    | Shoulder | Day 1–day 17 | 1.00        | –          | 100.00     | 1.6036  | 0.010*  |
|                    | Elbow | Day 1–day 17 | 1.33        | 0.58       | 100.00     | 1.6036  | 0.0108* |
| Local temperature  | Ankle | Day 1–day 17 | 0.96        | 0.44       | 1.00       | 2.5205  | 0.0117* |
|                    | Knee  | Day 1–day 17 | 1.19        | 0.62       | 1.21       | 2.8031  | 0.0051* |
| Tenderness         | Ankle | Day 1–day 17 | 2.50        | 0.53       | 62.50      | 2.5205  | 0.0117* |
|                    | Knee  | Day 1–day 17 | 2.30        | 0.48       | 67.65      | 2.8031  | 0.0051* |
|                    | Shoulder | Day 1–day 17 | 2.67        | 0.58       | 72.73      | 1.6036  | 0.010*  |
|                    | Elbow | Day 1–day 17 | 2.00        | 1.00       | 66.67      | 1.6036  | 0.0108* |
| Swelling           | Ankle | Day 1–day 17 | 2.33        | 1.03       | 63.64      | 2.2014  | 0.0277* |
|                    | Knee  | Day 1–day 17 | 1.38        | 0.66       | 5.86       | 2.5206  | 0.0117* |
|                    | Shoulder | Day 1–day 17 | 0.99        | 0.38       | 2.70       | 2.8031  | 0.0051* |
| Manual muscle testing | Ankle | Day 1–day 17 | 1.63        | 1.69       | 92.86      | 1.8904  | 0.0487* |
|                    | Knee  | Day 1–day 17 | –2.30       | 0.67       | –153.33    | 2.8031  | 0.0051* |
|                    | Shoulder | Day 1–day 17 | –2.00       | –          | –75.00     | 1.6036  | 0.010*  |
|                    | Elbow | Day 1–day 17 | –1.33       | 0.58       | –57.14     | 1.6036  | 0.0108* |
|                    | Wrist | Day 1–day 17 | –2.00       | –          | –120.00    | 2.2014  | 0.0277* |

Note: *p < 0.05.
injury [14,15]. *Manjishtadi lepa* (Fig. 4) (Tables 1 and 2) application in inflammatory stage i.e immediate rehabilitation helps in reduction of pain, swelling and temperature [16]. The local application of cold therapy agents suppresses the metabolic rate of the surrounding soft tissue and lowers microcirculation or perfusions of capillaries beneath the injured tissue by more than 60%, thus reducing extravasation of blood into surrounding tissues, local inflammation and decreases in motor and sensory nerve conduction [17]. Early Mobilization (Fig. 4) (Tables 1 and 2) of affected joint with *kusha* (splint) application helps in reduction of blood flow, facilitating the translocation of edema from the injured site to proximal normal tissues where it is effectively evacuated by the lymphatic system [18]. Previous studies states that combined effect of cold and compression helps in temperature reduction and speeds up the lymph evacuation process [19]. *Bhadarakadi ghrita* (Chee preparation with medicated drugs) (Tables 1 and 2) a formulation popularly known as ‘param rujahara’ (alleviates pain) specially indicated in *marmaghata* (injury to vital points) [20]. *marma gutika* (Table 1) containing 35 drugs indicated in the pain management of injury to vital structures [20].

### 4.2. Intermediate rehabilitation (repair and regeneration of tissue and improve muscle performance)

*Murrivenna* oil (Tables 1 and 2) is known for its anti-inflammatory activity, thus application in *pichu* form (Fig. 4) increases drug skin contact time, permeability of the skin and enhances the bioavailability of the drugs thus providing a synergistic effect to reduce pain and swelling [21]. TENS (Fig. 5) is simple and non-invasive treatment indicated in the treatment of acute and chronic pain [22,23]. In this procedure, electrical current is provided through the skin which reduces central excitability thus inhibiting the nociceptive neurons of the spinal cord there by reduces pain (pure gate theory) [24]. Isometric exercises (IM) (Table 3) are important in the early phase of rehabilitation to minimize muscle atrophy [24,25]. In an immobilized joint practice of IM helps in protecting the integrity of joint structure, stimulates muscle fibers, improves local blood circulation and also prevents intra articular, peri articular adhesions thus enhancing range of joint motion [25].

### 4.3. Advanced rehabilitation (muscle strengthening and improve ROM)

Inferential therapy (Fig. 5) is indicated for pain relief in musculoskeletal injuries and researches have proved that it does stimulation of muscles, reduces swelling and boosts up the healing process [23,26]. Incorporating muscle strengthening exercises (Tables 2 and 3) in the earlier phase helps in improving muscular strength, dynamic postural stability and endurance of sports person

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**Table 3**

| Parameter | Baseline | 6th day | 11th day | 17th day |
|-----------|----------|---------|----------|----------|
| Pain (VDS) | 9.07 ± 1.14 | 7.40 ± 1.50*** | 5.60 ± 1.40*** | 3.17 ± 1.51*** |
| Loss of Function | 1.57 ± 0.50 | 1.27 ± 0.45*** | 0.70 ± 0.47*** | 0.17 ± 0.38*** |
| Tenderness (modified di-Cipriano scale) | 3.60 ± 0.56 | 2.80 ± 0.61*** | 2.21 ± 0.56*** | 1.23 ± 0.50*** |
| Local Temperature | 96.85 ± 2.05 | 96.64 ± 2.11*** | 96.36 ± 2.02*** | 95.96 ± 2.16*** |
| Swelling | 28.20 ± 10.50 | 27.86 ± 10.55*** | 27.40 ± 10.40*** | 26.97 ± 10.40*** |
| Manual muscle testing | 1.80 ± 1.00 | 2.40 ± 0.72*** | 3.00 ± 0.83*** | 3.73 ± 0.78*** |

**Active Range of motions - Non weight bearing**

| Joint | Baseline | 6th day | 11th day | 17th day |
|-------|----------|---------|----------|----------|
| Wrist flexion | 47.67 ± 5.01 | 52.33 ± 4.08* | 56.33 ± 3.50* | 60.00 ± 0.00* |
| Wrist extension | 49.67 ± 4.93 | 52.50 ± 4.59* | 56.00 ± 3.74* | 58.83 ± 2.04* |
| Wrist radial deviation | 13.00 ± 12.6 | 14.67 ± 1.37* | 17.67 ± 1.97* | 19.67 ± 0.82** |
| Wrist ulnar deviation | 17.83 ± 3.97 | 20.83 ± 5.34* | 22.67 ± 5.16* | 23.17 ± 4.79* |
| Shoulder flexion | 153.33 ± 15.28 | 162.67 ± 14.19 | 168.33 ± 10.41 | 180 ± 0.00 |
| Shoulder extension | 35.33 ± 0.58 | 38.33 ± 3.51 | 42.00 ± 5.29 | 47.33 ± 1.15 |
| Shoulder abduction | 151.67 ± 18.93 | 162.67 ± 15.70 | 168.33 ± 7.64 | 175.33 ± 0.58 |
| Shoulder Adduction | 69.33 ± 10.07 | 71.67 ± 7.64 | 78.00 ± 10.00 | 85.00 ± 7.81 |
| Shoulder lateral | 77.67 ± 8.74 | 81.67 ± 5.77 | 83.33 ± 7.64 | 89.33 ± 1.15 |
| Elbow flexion | 98.33 ± 18.93 | 113.33 ± 20.82 | 128.33 ± 7.64 | 140.00 ± 0.00 |
| Forearm pronation | 59.33 ± 9.02 | 69.00 ± 7.94 | 72.67 ± 11.02 | 78.67 ± 2.31 |
| Forearm supination | 66.67 ± 2.89 | 68.00 ± 8.19 | 75.00 ± 0.00 | 80.00 ± 0.00 |
| Ankle dorsiflexion | 14.88 ± 2.59 | 17.25 ± 1.58* | 17.88 ± 1.13** | 19.75 ± 0.71*** |
| Ankle plantar flexion | 27.25 ± 4.53 | 30.38 ± 5.10* | 33.75 ± 4.43*** | 36.63 ± 4.44*** |
| Ankle inversion | 27.25 ± 4.19 | 29.25 ± 5.18*** | 30.75 ± 1.49*** | 33.63 ± 1.77*** |
| Ankle eversion | 8.00 ± 0.53 | 8.63 ± 0.74*** | 10.25 ± 0.46*** | 11.13 ± 0.64*** |
| Knee flexion | 134.00 ± 16.32 | 136.10 ± 17.06*** | 141.60 ± 14.89 | 145.70 ± 9.15 |
| Knee extension | 0.70 ± 0.95 | 0.30 ± 0.67 | 0.30 ± 0.48 | 0.20 ± 0.42 |

Note: *p < 0.05, **p < 0.01, ***p < 0.001.
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Joint results were insignificant which may be due to less samples (10% each). Joint complexity, severity of the injury as CT and MRI scan were not performed to assess the injury level, short treatment period.

Evaluation of complementary and alternative medicine interventions needs a whole system research (WSR) approach which essentially focuses on single patient and helps to provide individualized treatment care. Sports injuries are complex, which requires quantitative and qualitative research methods to analyse the outcome so WSR provides a multidimensional approach towards healing. Future research works on both preventive and curative aspects of sports injuries is essential in the path of WSR for providing customise care for sports person [35].

5. Conclusion

Integrated treatment approach for common sports injuries has given significant results in the parameters like pain, swelling, loss of function, tenderness, local temperature, manual muscle testing and range of motions of wrist, knee and ankle joint. Phase wise management by integrated protocol is effective in the management of common sports injuries.

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Conflict of interest
None.

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