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Evidence-Based Management of Fracture Healing through Sri Lankan Traditional Medicine: Case Series

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ABSTRACT:
Sri Lanka`s traditional medical system for treating fractures has a long history and reflects the rich cultural heritage of the country. The study has been focused on evaluating the role of Sri Lanka`s traditional treatment modalities for fracture healing. The patients were purposively selected for the study and data was collected by adopting special Performa. The patients have undergone an external native treatment regimen for one month. The pain assessment scale and edema grade score were used to assess the reduction of pain and edema. The herbal ingredients used in the traditional treatment revealed a range of beneficial effects including antibacterial, antifungal, antiviral, antioxidant, immunomodulatory, bone regenerative, wound healing, and antipyretic properties. These properties suggest that the natural formulas utilized in the study have the potential to manage the healing process effectively. However, it`s crucial to emphasize that further research is needed to validate these findings and comprehend the precise mechanisms through which these properties contribute to the healing process.

KEYWORDS: Fractures, Sri Lanka`s Traditional Treatments**,** Swelling,

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INTRODUCTION:

Fractures are a common orthopedic ailment, characterized by the breakage of bones due to trauma or other factors, and pose significant challenges in the realm of medical treatment and recovery. In this context, exploring and understanding alternative treatment approaches, particularly those deeply rooted in traditional practices, is of paramount importance. In Sri Lanka; the traditional practices, often passed down through families or communities, hold a treasure trove of knowledge that can contribute significantly to modern approaches.

Contemporary medical approaches to fracture healing primarily involve surgical intervention, and casting using modern orthopedic devices. While these methods have shown efficacy, may produce risks and extended use of casts can lead to muscle atrophy and joint stiffness. Furthermore, the management of pain, inflammation, and

tissue regeneration remains a challenge in conventional approaches.

The indigenous orthopedic treatments, practiced by the "*Moragammana*" Traditional Medical Family, in Kandy district, central province of Sri Lanka offer a promising alternative. These treatments leverage herbal formulas and external applications, which as suggested by the preliminary pharmacological properties, exhibit antibacterial, anti-inflammatory, and regenerative effects. Bridging the gap between traditional and contemporary healthcare systems is an overarching goal of this study. Hence this study was designed to explore the role of indigenous orthopedic treatment in fracture healing and seeks to unlock the potential of traditional practices in modern healthcare.

Key information of case studies

The study included five patients, both males and females within the age range of 18-45 years. These patients had a history of fractures and sought traditional treatments from *Moragammana* traditional dispensary, *Gampola, Kandy* District in the central province, of Sri Lanka. The patients who presented with fractures in the upper and lower limbs along with pain, swelling, and restricted movements for less than 3 days and more than 3 months and confirmed through radiological investigations at the modern hospital were considered as eligible for the study. Informed co

nsent was obtained from all participants prior to the commencement of the study.

The severity of the clinical features including pain, swelling, and restricted range of movements were measured and recorded. The pain assessment scale and edema grade score were used to evaluate the respective parameters. The duration of the treatment was one month.

Summary of the case series

Case: 1

A twenty-six-year-old male patient presented with pain, gross swelling below the left knee joint, and restricted movements in the left leg. The symptoms had an acute onset following a motorbike accident before 3 months. He was diagnosed at the modern hospital with a left tibial shaft nondisplaced fracture and undergone allopathic treatments and immobilization with plaster of Paris (POP) [Figure 1]

Case:2

A forty-five-year-old- male patient presented with severe pain, swelling, and restricted movements in the right forearm for two months was diagnosed at the modern hospital as a non-displaced right distal ulnar shaft fracture. He was followed by allopathic treatment prior to the traditional treatments.

Case: 3

A sixty-one years old female patient was diagnosed at the modern hospital with a left medial malleolus non-displaced fracture due to direct trauma to the left ankle joint presented with pain and swelling for 3 months followed by modern treatments and immobilization with POP for 1 month[Figure 2].

Case: 4

An eighteen years – old male patient was diagnosed at the modern hospital as a right proximal ulnar shaft non displaced fracture due to the fall and knocked at elbow joint presented with severe pain & swelling with difficulty in moving the right forearm since one day [Figure 3].

Case: 5

A twenty-nine years old male patient with severe pain, swelling, and reduced movements in the right arm at the elbow joint since one day due to the direct trauma was diagnosed as a fracture in the right olecranon by the western medical physicians. The patient directly came for native treatment.

Treatment protocol

According to the table [Table: 01], the treatment period for the patients in the study was 30 days.

Fractures in the Acute stage

For new fractures within the past 3 days, castor oil was applied externally, and fomentation (Figure 04) was given at the commencement of the treatment. Initially, a paste was applied externally (Figure 5), followed by a bandage with bamboo splinters (*Bambusa vulgaris*) to minimize the mobilization (Figure 9-18), and patients were advised to keep it for two days. Subsequently, the external medication was removed at 8:00 a.m. in the morning, and a wilted herbal formula was reapplied as per the schedule (Figure 5-8). The treatment schedule was continued for 30 days, following the schedule outlined below:

Fracture in chronic stage

For old fractures with a history of less than 3 months, cow ghee was applied externally and same procedure was followed as per the Table 01.

Additionally, the wilted herbal formula was applied after the fomentation to the affected area throughout 30–day treatment period. No internal medicine was prescribed to the patients registered for the study.

Sequelae of the scheduled external treatments for the registered fracture patients

1. Oil application by Ghee or Castro oil based on the chronicity
2. Fomentation with herbal bundles in every two days within the treatment period by
   A- Nikadi Thawilla
3. Wilted herbal formulae (*Mallum*) from the 2nd day – 30th day
   B- Kotadibuladi Mallum - From 1st -2nd day
   C- Hikpotuadi Mallum - From 3rd -5th day
   D- Navahandi adi Mallum - From 6th -14th day
   E- *Haran kaha adi Tel kira* - From 15th – 30th day
4. Immobilized by Bambo (*Bamboosa vulgaris*) Splinters (*Paturu*) from 1-30th day

The treatment process involves the removal of splinters, followed by the application of oil and fomentation, and then the administration of a wilted herbal formula. This schedule [Table 01] suggests a regular cycle of treatment.

Preparation of *Nikadi thawilla* (Herbal bundles-A)

The herbal materials (Table 2) including seeds, leaves, and the entire plant were properly cleaned. In addition to seeds, leaves were also sliced into smaller particles. Plants and rhizomes were chopped. Using a white cotton fabric measuring 15" by 15", was used to prepare the spherical bundles from the combined materials and tied them up with cotton threads. Kept those into the steamer to make the bundles hot (*Wandu Thambuma*).

Preparation of *Kotadibuladi Mallum* (Wilted Herbal formulae- B)

Properly cleansed equal quantity (100gm) of ingredients [Table 3] were chopped and grinded. Then 30gms of salts and 50 gm of powder were mixed and wrapped with banana leaves and kept in the steamer until cooked.

Preparation of *Hikpotuadi Mallum* (Wilted Herbal formulae- C)

Properly cleansed (400gm) of *Hik potu* (*Lannea coromandelica*) chopped and grinded with fresh milk (100ml) and cooked under moderate fire till it became semi-solid in consistency (Table 4).

Preparation of *Navahandi adi Mallum* (Wilted Herbal formulae- D)

The ingredients mentioned (Table 5) herbal materials have been washed properly and grinned with coconut milk. Cooked under moderate fire until it becomes semi-solid material.

Preparation of *Haran kaha adi Tel kira* (Wilted Herbal formulae- E)

The ingredients mentioned [Table 6] have been washed properly and an equal quantity of leaves and bark of each fresh plant were grinned with coconut milk. Subsequently added *Mee oil* (*Madhuka longifolia*), *Kithula pani* (*Caryota urens*), *Kurakkan* powder (*Eleusine coracana*), and Hal panu Diya (Rice water). Cooked under moderate fire until it becomes semi-solid material.

Before the treatment

Figure 1: Case 1

Figure 2: Case 3

Figure 3: Case 4

Figure- 4: Preparation of fomentation (*Tawilla*)

A- Nikadi Tawilla

Preparation of different wilted herbal formulae (*Mallum*)

Figure: 5

B- Kotadibuladi Mallum

Figure: 6

C- Hikpotuadi Mallum

Figure: 7

D- Navahandi adi Mallum

Figure: 8

E-Haran kaha adi Tel kira

Table-1: Treatment Regimens used for the patients with different fractures

Clinical case	Chronicity	Duration	Clinical features	X-ray findings	Treatment Regimen			
					1st regimen (1-2 days)	2nd regimen (3-5 days)	3rd regimen (6-15 days)	4th regimen (16-30 days)
Case: 1	Chronic	3 Months	Pain & Swelling with restricted movements	left tibial shaft nondisplaced fracture	B	C	D	E

Case: 2	Chronic	2 months	Pain & Swelling with restricted movements	non-displaced right distal ulnar shaft fracture	B	C	D	E
Case: 3	Chronic	3 Months	Pain & Swelling with restricted movements	left medial malleolus non displaced fracture	B	C	D	E
Case: 4	Acute	1 Day	Severe Pain & Swelling with restricted movements	right proximal ulnar shaft non displaced fracture	B	C	D	D
Case: 5	Acute	1 Day	Severe Pain & Swelling with fracture in the right olecranon	Right arm elbow fracture	B	C	D	D

Table-2: Ingredients of *Nikadi Thawilla* (bundles for herbal fomentation-A) [6,7,8,9,10,11,13,14, 17,15,16,19,31,32,34]

Local Name	Botanical Name	Part used
Nika	*Vitex negundo* L.	Leaves
Beli	*Aegle marmelos* L.	leaves
Adatoda	*Adathoda vasica* L	leaves
Iramusu	*Zingiber officinale Roscoe.*	leaves
Belatana	*Eleusine indica* L.	leaves
Polpala	*Aerva lanata* L.	Whole plant
Kottapol	Cocos nucifera L.	fruit
Sudulunu	*Allium sativum* L.	Rhizomes
Amu Iguru	*Zingiber officinale Roscoe.*	Rhizomes
Aba	*Brassica alba* L.	Seeds
Eradu	*Ricinus communis* L.	Seeds
Mee	*Madhuca longifolia*	Seeds
Kuburu	*Guilandina bonduc* L.	Seeds
Tala	*Sesamum indicum* L.	Seeds

Table- 3: Ingredients for *Kotadibuladi Mallum* (Wilted herbal formulae -B) [18,20,22, 33]

Local Name	Botanical Name	Part used
Kotadimbula	*Ficus hispida*	Leaves & Bark
Midella	*Barringtonia racemosa*	Leaves & Bark
Burulla	*Leea indica*	Leaves & Bark

Table- 4: Ingredients for *Hikpotuadi Mallum* (Wilted herbal formulae -C) [23]

Local Name	Botanical Name	Part used
Hik	*Lannea coromandelica* (Houtt)	Bark
Cow milk		

Table- 5: Ingredients for *Navahandi adi Mallum* (Wilted herbal formulae -D) [9,25,26,27,28,29]

Local Name	Botanical Name	Part used
Nawahandi	*Rhipsalis baccifera*	leaves
Olinda	*Abrus precatorius*	leaves
Kirianguna	*Wattakaka volubilis*	leaves
Elabinthamburu	*Ipomoea pes-caprae L.*	Whole plant
Hathawariya	*Asparagus racemosus*	Rhizomes
Pol	*Cocos nucifera*	Pulp of the fruit

Table -6: Ingredients for *Tel Kiri* (Semisolid herbal formulae -E) [15,21,34]

Local Name	Botanical Name	Part used
Haran Kaha	*Curcuma zedoaria*	Rhizomes
Amu Kaha	*Curcuma longa*	Rhizomes
Katu Ibula	*Bombax ceiba*	Leaves & Bark
Hathawariya	*Asparagus racemosus*	Rhizomes
Pol	*Cocos nucifera*	Pulp of the fruit
Mee oil	*Madhuka longifolia*	Seeds
Kithul Pani	*Caryota urens*	Flower
Hal Panu Diya	Rice water	
Kurakkan powder	*Eleusine coracana*	Seeds
Egg		

Procedure of bandaging using herbal bamboo (*Bamboosa vulgaris*) Splinters (*Pathuru*) after administrating the wilted herbal formulae for Ulnar Fracture (Fig 6-11)

Figure: 9

Figure: 10

Figure: 11

Figure: 12

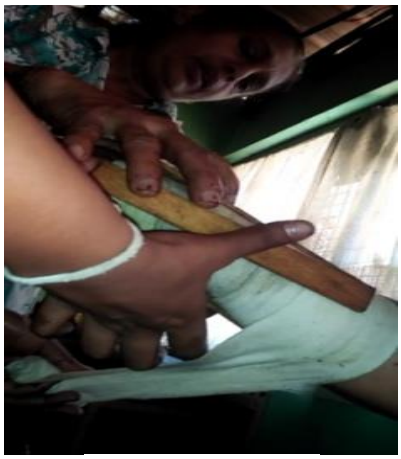


Figure: 13

Figure: 14

The procedure of bandaging using herbal bamboo (*Bamboosa vulgaris*) Splinters (Pathuru) after administrating the wilted herbal formulae for Tibial Fracture (Fig 12-15)

Figure: 15

Figure: 16

Figure: 17

Figure: 18

Assessment criteria

Table- 7: Pain Assessment Scale - Numerical Rating Scale (NRS) [30]

Grade	Pain	Description of experience
10	Unable to move	The patient is in bed & can't move due to pain.
9	Severe	Pain is all that the patient can think about. The patient can barely move because of the pain.
8	Intense	The pain is so severe that it is hard to of anything else. talking &l listening is difficult.
7	Unmanageable	The patient is in pain at the time. It keeps them from doing most activities.
6	Distressing	Patients think about that pain all of the time. The patient gives up many activities because of pain.
5	Distracting	Patients think about that pain most of the time. they can't do some of the activities. they need to do each day because of the pain.
4	Moderate	The patient is constantly aware of the pain but can continue most activities.
3	Uncomfortable	patient bothers their pain. but they can ignore it most of the time.
2	Mild	The patient has a low level of pain. The patient is aware of the pain only when he attends to it.
1	Minimal	Pain is hardly noticeable.
0	no pain	They have no pain.

Table -8: Edema Grade Score [35]

Grade	Edema	Description of experience
1+	Trace	Pitting/ impression of 2 mm or less, rebounding immediately. No visible deformity
2+	Mild	Swelling with no visible deformity. The pit is between 2-4 mm and takes up to 15 seconds
3+	Moderate	A noticeably deeper pit of 4-6 mm that lasts for 30 seconds. Swelling is more intense in the surrounding area
4+	Severe	A pit of 6 mm to 8 mm in depth that takes more than 30 seconds to disappear, accompanied by visible deformity and swelling in the are

Table 9: Percentage-wise reduction of clinical features

Cases	Smptoms	1st week	2nd week	3rd week	End of the month
Case 1	Pain	90	70	60	20
	Swelling	100	75	50	25
Case 2	Pain	100	80	50	10
	Swelling	100	75	75	50
Case 3	Pain	90	80	50	10
	Swelling	100	75	50	25
Case 4	Pain	100	80	60	30
	Swelling	100	75	50	25
Case 5	Pain	100	80	50	20
	Swelling	100	75	50	25

OBSERVATION & RESULTS

Effect of treatment regimen on Pain and Swelling

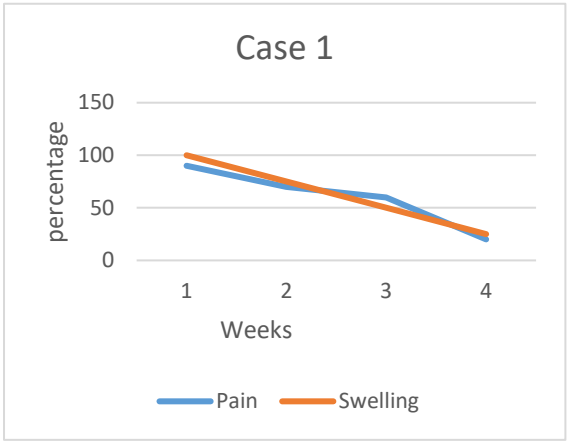
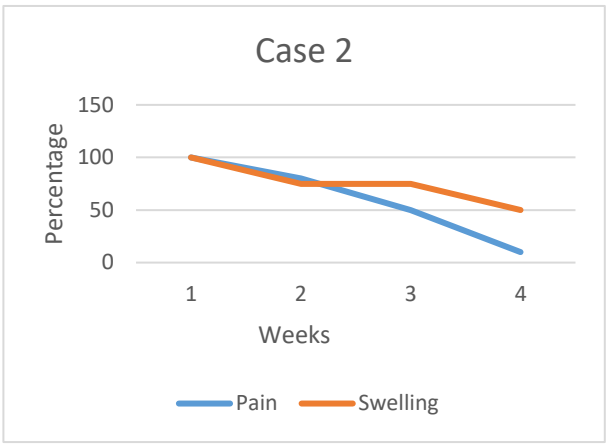


Figure 19



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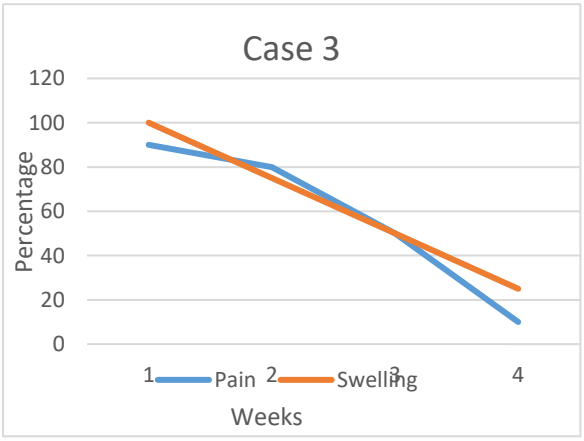

Figure 21

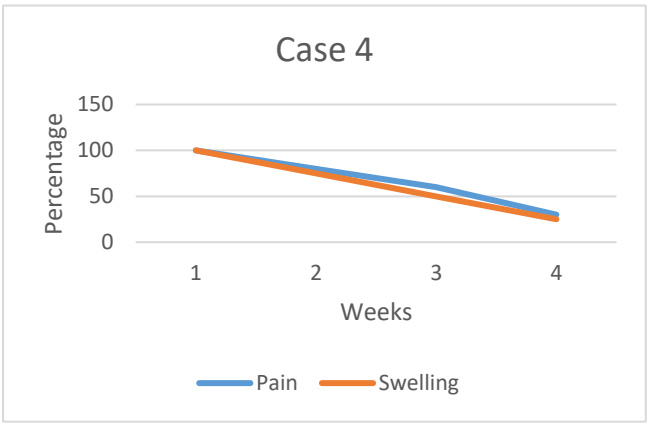

Figure 22

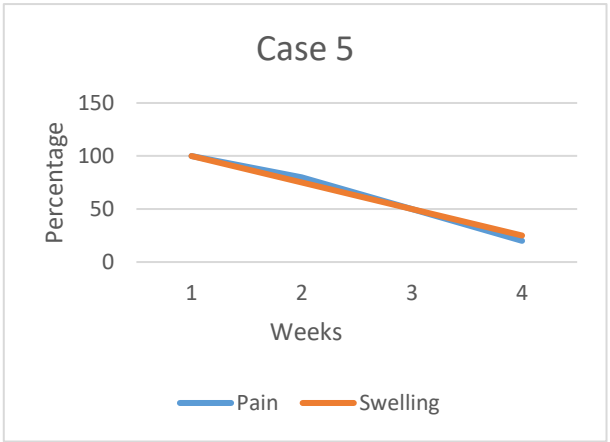

Figure 23

Table 10: Pharmacodynamics potential of the ingredients of herbal plants used in fracture treatment

Local Name	Botanical Name	Rasa	Guna	Veerya	Vipaka	Pharmacological properties
Nika	*Vitex negundo*	Tikta, Katu, Kashaya	Lagu Ruksha	Ushna	Katu	Anti-inflammatory, Analgesics, CNS depressant activities, Antifungal and ant-bacterial activity [7]
Beli	*Aegle marmelos*	KashayaTikta	Ruksha Lagu	Ushna	Katu	Analgesic, Antioxidant, Antipyretic, and Anti-inflammatory [6]
Adatoda	*Adathoda vasica*	Tikta	Lagu	Sheetha	Katu	Anti-inflammatory and anti-microbial activity, wound healing activity [10]
Iramusu	*Hemidesmus indicus*	Madura Tikta	Guru, Snigda	Sheetha	Katu	Antibacterial, Antioxidant, Anti-inflammatory, Antipyretic, Analgesic [12,31,32]
Balatana	*Eleusine indica L.*	Madura Tiktu Katu	Guru, Snigda	Sheetha	Katu	Antibacterial, Antioxidant [36]
Polpala	*Aerva lanata*	Tikta Katu	Lagu, Ruksha Thiksha na	Ushna	Katu	Anti-inflammatory, Antibacterial, Mild Analgesics [8]
Kottapol	*Cocos nucifere L.*	Madura	Guru, Snigda	Sheeta	Madhura	Antibacterial, Antioxidant, Antiviral, Antifungal, Immunomodulatory [9]
Sudu Lunu	*Allium sativa L.*	MadhuraLavna Katu Tikta Kashaya	Snighdha Guru Theeksh na	Ushna	Katu	Antibacterial, Antioxidant, Anti-inflammatory [11]
Iguru	*Zingiber officinale*	Katu	Ruksha, Guru Thikshn a	Ushna	Madura	Antioxidant, Anti-inflammatory [14]

Aba	*Brassica juncea*	Katu Tikta	Theeksh na Ruksha	Ushna	Katu	Antioxidant, Anti-inflammatory, Anti-fungal [13]
Endaru	*Ricinus communis*	Madura Katu Tikta	Guru, Snigda Thikshn a	Ushna	Madura	Anti-inflammatory, Bone regenerative, Analgesics, Antioxidant, Antimicrobial Insecticidal [17]
Mee	*Madhucalongi folia*	Madhura	Guru Snigdha	Sheeta	Madhur a	Anti-diabetes, Anti-inflammatory, Antioxidant, Anti-ulcer [15]
Kuburu	*Guilandina bonduc* L.	Laghu, Ruksha	Katu Kashya	Ushna	Katu	Antibacterial, Antifungal, Ant parasitic, antioxidant, antipyretic, anti-inflammatory [16]
Tala	*Sesamum indicum Linn.*	Madura Tikta Kashaya	Guru Snigdha	Ushna	Madura	Antioxidant, anti-inflammatory, Healing wounds, and Enhancing the skin complexion [19,34]
Kotadimbula	*Ficus hispida*	Tikta Kashaya	Ruksha Lagu	Sheetha	Katu	Analgesic, Antibacterial, Anti-inflammatory [18]
Midella	*Barringtonia racemosa*	Tikta	Lagu	Sheetha	Katu	Analgesic, Antibacterial, and Anti-inflammatory [20]
Burulla	*Leea indica*	Tikta	Lagu	Sheetha	Katu	Antioxidant, Antibacterial, Anti-inflammatory, Wound healing [22,33]
Hik	*Lannea coromandelica*	MaduraKatu kashayaLavana	Snehana, Vruna Ropaka	Ushna	Katu	Anti-bacterial, Antifungal, Anti-inflammatory, Anti-Viral, Heal wounds [23]
Kaha	*Curcuma longa*	Tikta Katu	Ruksha Lagu	Ushna	Katu	Antioxidant, Antibacterial, Anti-inflammatory, Neuroprotective, Wound healing [21,34]
Kirianguna	*Wattakaka volubilis*	Tikta	Sheetha	Stheetha	Katu	Anti-inflammatory, Analgesic, Antioxidant, Antibacterial [25]

Kumburu	*Caesalpinia b onduc*	Katu Tikta	Lagu, Ruksha Thikshn a	Ushna	Katu	Anti-inflammatory, Analgesic, Antioxidant [24]
Nawahandi	*Rhipsalis bac cifera*	Tikta	Lagu	Ushna	Katu	Anti-inflammatory, Anti-microbial, fracture healing [28]
Olinda	*Abrus precat orius*	Tikta, Kashaya	Lagu, Ruksha Thiksha na	Ushna	Katu	Anti-viral, Anti-malarial, Immunomodulatory, and anti-inflammatory [27]
Elabinthab uru	*Ipomoea pes-caprae L.*	Tikta, Kashaya	Lagu, Ruksha Thiksha na	Ushna	Katu	Anti-inflammatory, Analgesic, Antioxidant, Antimicrobial [26]
Hatavariya	*Asparagus racemosus*	Madhura Tikta	Guru Snigdha	Sheeta	Madhur a	antifungal activity, antibacterial activity, anti-inflammatory activities, antiulcer activity, antioxidant activity [29]

Distribution of dominant Pharmacodynamics potential of the ingredients of herbal plants used in fracture treatment

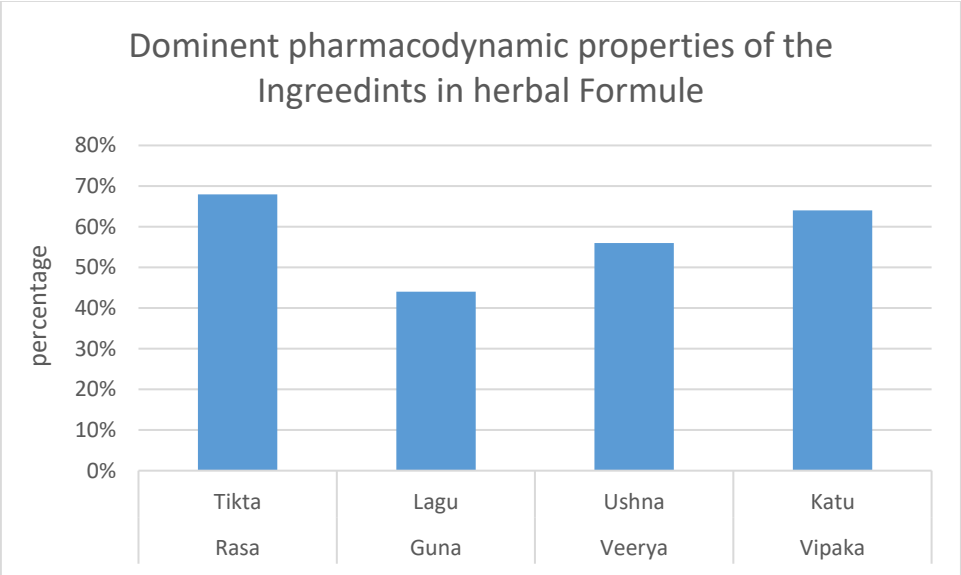

Figure 24

DISCUSSION:

The present observational study includes five patients with various fractures in their upper and lower limbs, all experiencing pain and swelling. After a 30–day treatment, an average reduction of 78% and 70% in pain and swelling was observed respectively. This positive outcome could be attributed to the anti-inflammatory and analgesic properties of the ingredients present in the herbal formulae used [Table 10].

Based on the findings mentioned above, it was further observed that 68% of the ingredients in the herbal formulae had *Tika Rasa* (bitter taste), 44% had *Laghu Guna* (Light quality), 56% had *Ushna Veerya* (Hot in potency), and 64% had *Katu Vipaka* (Hot in potency), according to the Ayurveda viewpoint [Figure 24]. These characteristics align with Ayurveda principles and may have contributed to the favorable outcome observed in the pain and swelling reduction.

Furthermore, the pathogenesis of fracture is attributed to the imbalance or vitiation of Vata and *Kapha Dosha*, as well as the involvement of *Rakta, Mamsa*, *Asthi*, and *Majja Dhatu* [3,4,5]. The herbal formulae used in this study possess properties such as *Tika Rasa, Lagu Guna*, *Ushna Veerya*, and *Katu Vipaka* which have the potential to pacify Vata and *Kapha Dosha*, thereby reducing pain and edema. *Ashi Dhatu* is where the Vata Dosha resides, and the pacification of Vata *Dosha* occurs due to the *Tikta Rasa* and *Ushna Veerya* properties of all the formulas used during the treatment, which supports the pacification of *Asthi Dhatu*.

A critical analysis of the properties of the ingredients revealed various beneficial effects including antibacterial, antifungal, antiviral, antioxidant, immunomodulatory, bone regenerative, wound healing, and antipyretic properties [Table 10]. These properties indicate that the natural formulae used in the study have the ability to provide efficient and effective management of the normal healing process.

It should be noted, that controlled clinical trials and a better understanding of the underlying biological process are required to establish the full potential and clinical applicability of these natural treatments in fracture healing. However, it is important to note that further research is necessary to investigate the safety and efficacy of novel therapeutic interventions.

CONCLUSION

Based on the afore mentioned study, it can be concluded that Sri Lankan traditional treatment has demonstrated successful orthopedic management of pain and swelling, and no adverse reactions were noted during the treatment period.

Limitation of study:

Additionally, larger sample sizes and controlled studies are necessary to validate these findings and explore the potential benefits of Ayurveda approaches in orthopedic management. Additionally, the clinical findings obtained from this study should be transferred into clinical practice to enhance patient care treatment outcomes.

Consent of patients:

Already Received.

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