HEALTHY FEET, HEALTHY ELEPHANTS

A GUIDE TO FOOT CARE IN CAPTIVE ASIAN ELEPHANTS

EDITOR (S)

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PROJECT ELEPHANT
GOVT. OF INDIA

भारतीय वन्यजीव संस्थान
Wildlife Institute of India

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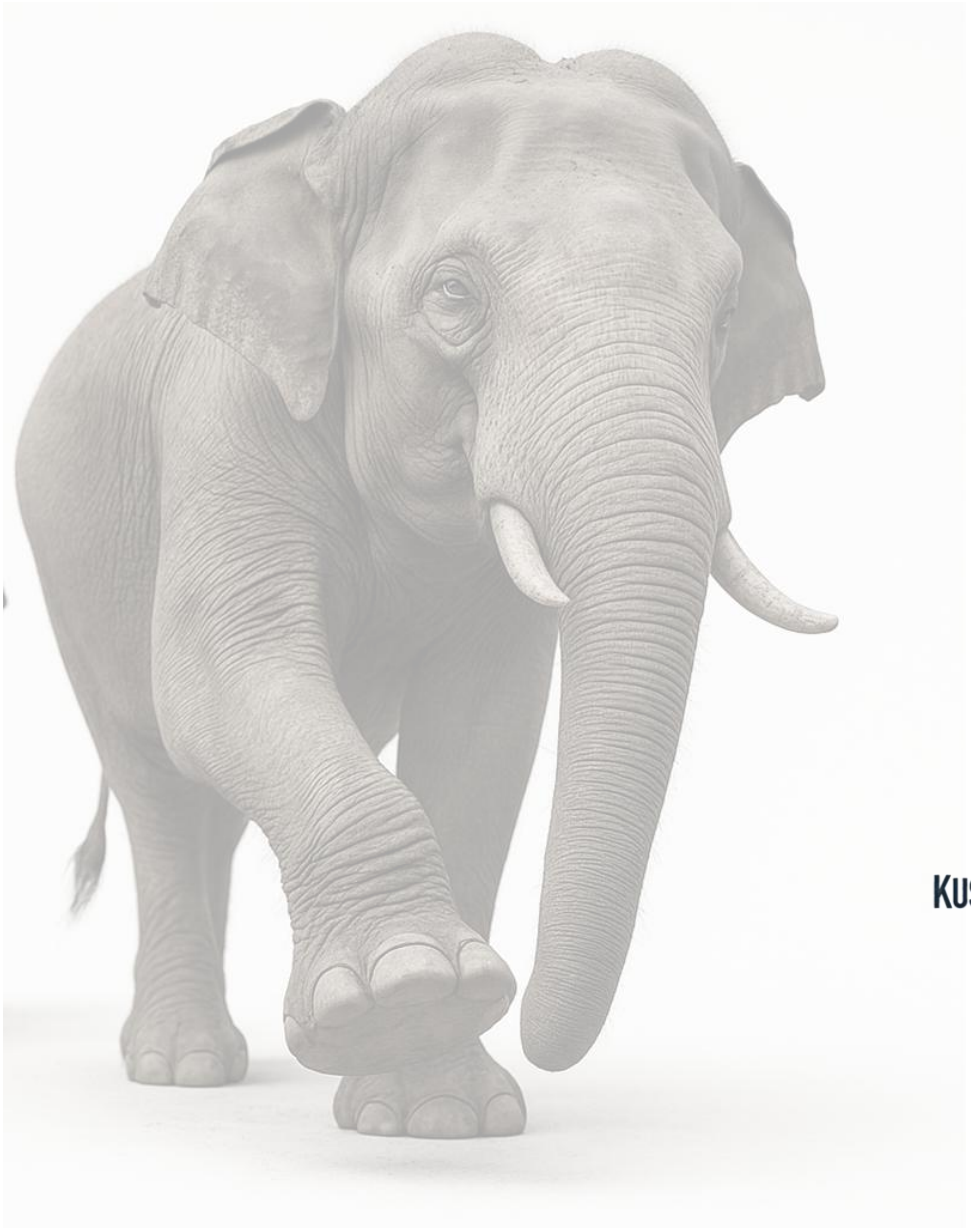

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भूपेन्द्र यादव
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GOVERNMENT OF INDIA

FOREWORD

As we celebrate the majesty and wisdom of elephants, which are revered in Indian culture, it is also our collective responsibility to ensure their well being both in the wild and directly under human care. Welfare of elephants that are directly under human care is challenging. I am happy that Project Elephant is taking steadfast efforts to improve the welfare standards through stakeholder engagement and also embracing the best of science into management, wherever possible.

Experts in elephant husbandry, elephant lovers, wildlife enthusiasts, and members from the various MoEFCC committees have often highlighted the importance of maintaining healthy foot for elephants as foot health is directly linked to their overall health in confined conditions. It is not well understood that foot ailments seriously affect the quality of life and longevity of elephants in captivity. Thus, it is imperative to advance science-based foot management of elephants in captivity. Despite this recognition, getting expert advice on foot care for field personnel is not easy. To overcome this concern, the Project Elephant along with the Elephant Cell at the Wildlife Institute of India constituted an expert committee with in-depth field experience along with the scientific acumen to come up with an elephant foot care manual that is practical to use in the field, but also comprehensive in scope. With zeal and focussed deliberations, the committee has brought out a much-awaited manual on practical knowledge "Healthy Feet, Healthy Elephants: A Guide to Foot Care in Captive Asian Elephants." This manual basically leverages the collective expertise of renowned professionals from across the country, bringing together diverse perspectives and knowledge to advance the well being of captive elephants.

This manual provides invaluable insights and practical recommendations for improving foot care, emphasizing hygiene, prevention, early diagnosis, and caregiver training. I extend my sincere appreciation to all contributors for sharing their invaluable insights and expertise, which will undoubtedly benefit the care and management of these majestic animals

(Bhupender Yadav)

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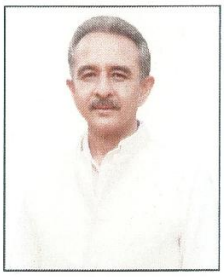

FOREWORD

In India, elephants are deeply rooted in our culture and heritage as symbols of strength, wisdom, and prosperity. Their significance in our traditions, religion, and folklore underscores the reverence with which they are regarded. India is home to the largest population of Asian elephants in the world. During the last few years, the country has taken several steps to ensure their conservation and welfare, both in wild and captive settings. These efforts are supported by comprehensive legislation, informed policies, and coordinated initiatives under the aegis of Project Elephant and its technical partners. While landscape conservation and holding on to remnant populations constitute the key for wild elephant conservation, captive elephant welfare rests on improving their welfare prospects.

Among the various aspects of captive elephant management, foot care holds particular importance in the context of captive elephants. Due to restricted movement, artificial flooring, and changes in behavior under managed conditions, captive elephants are more prone to foot-related ailments. Timely detection and regular foot care are essential for ensuring their health and overall well-being.

Recognizing this, the Ministry of Environment, Forest and Climate Change (MoEF&CC), has initiated several efforts to strengthen veterinary and management capacities in elephant care. As part of these ongoing efforts, the MoEF&CC, through Project Elephant and in collaboration with the Wildlife Institute of India, has prepared a detailed manual on foot care in captive elephants.

The manual provides practical guidance on various aspects of foot health and care, including foot anatomy, common foot disorders, and preventive measures, cleaning and trimming procedures, and necessary tools and techniques. It aims to support frontline staff, veterinarians, mahouts, and elephant care institutions in adopting appropriate and consistent practices for foot care.

The manual draws expertise from a spectrum of experts from across the country, and I would like to thank all the contributors for providing their valuable inputs. I congratulate the authors of the manual and commend the dedicated efforts of Project Elephant and its partners in bringing out this important publication.

I am confident that this document will serve as a useful resource for all those engaged in the care and management of captive elephants in India.

(Kirti Vardhan Singh)

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FOREWORD

India's leadership in the conservation of large mammals such as the Asian elephant is rooted in its strong commitment to both embracing scientific management and at the same time nurturing and effectively using traditional knowledge. Over the years, the country has strengthened its approach to elephant management by integrating practical knowledge with evidence-based strategies, particularly in the context of captive animal care. Nevertheless, captive elephant management is far from easy and best practices have to continue to evolve. Thus, continuous learning and continuous adaption of new and latest techniques is the key to effective management.

Among the various aspects of elephant husbandry, foot care demands greater attention due to the unique challenges posed by captive environments. Factors like limited mobility, exposure to unnatural substrates, and extended periods of standing contribute significantly to the development of foot disorders. These issues, if unaddressed, can compromise the animal's health and lead to long-term welfare concerns.

In response to this pressing need, Project Elephant, in collaboration with the Elephant Cell at the Wildlife Institute of India, has developed a focused and user-oriented manual for captive elephants titled "Healthy Feet, Healthy Elephants: A Guide to Foot Care in Captive Asian Elephants". This manual provides structured guidance on various aspects of elephant foot care and is aimed at equipping veterinarians, mahouts, elephant handlers and other frontline personnel with scientifically standard pedicure procedures.

This publication is a welcome addition to the broader efforts aimed at improving the welfare of captive elephants in the country. I commend the team involved in its preparation and trust that it will prove valuable to all those engaged in the care and management of these magnificent animals.

(Tanmay Kumar)

Place: New Delhi
Dated: August 5, 2025

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MINISTRY OF ENVIRONMENT FOREST AND
CLIMATE CHANGE

FOREWORD

Scientific management of captive elephants demands close attention to several components of routine care, among which foot health holds critical importance. Unlike many other veterinary concerns, foot ailments in elephants tend to develop gradually and often go unnoticed until they manifest in advanced and painful conditions. Regular exposure to hard substrates, long durations of inactivity, and limited natural terrain in captive settings contribute to such conditions.

Addressing foot-related problems requires not only early detection and routine maintenance but also access to well-defined procedures and tools tailored to field realities. Lack of standardized guidelines, variation in local practices, and the need for skilled personnel have often posed challenges in ensuring consistent foot care across elephant-holding facilities.

Recognising these field-level limitations, Project Elephant, in collaboration with the Elephant Cell at the Wildlife Institute of India, has developed an important document on foot care for captive Asian elephants. The manual brings together practical experience, veterinary knowledge, and user-friendly guidance to support those involved in daily elephant management including mahouts, veterinarians, and institutional caregivers.

I would like to express my deepest appreciation to the esteemed experts who have contributed to this document, pooling their knowledge and experience to provide comprehensive guidance on foot care for captive elephants. I commend the effort of Project Elephant in developing this user-friendly document. It reflects a thoughtful synthesis of field experience and veterinary expertise, presented in a format that is both accessible and actionable. I am confident that this resource will support more consistent and informed practices in elephant foot care and contribute meaningfully to improving the welfare of captive elephants across India.

(Sushil Kumar Awasthi)

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MINISTRY OF ENVIRONMENT, FOREST
AND CLIMATE CHANGE

FOREWORD

India holds the largest and one of the most stable populations of the endangered Asian elephant. With elephants receiving the highest level of protection under the Wildlife (Protection) Act, 1972, their welfare both in the wild and in captivity remains a national priority. During the last few years, the Project Elephant of the MoEFCC, has consistently worked towards enhancing both conservation efforts and the quality of care for elephants under human supervision. A key component of these efforts involves strengthening the technical capacities of field personnel involved in routine elephant management.

In captive settings, one of the recurring and often under-addressed health concerns is related to foot conditions. Factors such as prolonged standing on hard surfaces, limited movement, and exposure to unsanitary environments can contribute significantly to foot ailments, which, if left untreated, can compromise the elephant's mobility, behaviour, and long-term welfare. Addressing this issue requires not only awareness but a structured and scientifically informed approach to regular footcare. With this in view, the Project Elephant Division, in collaboration with the Wildlife Institute of India, has developed this comprehensive Foot Care Manual for Captive Elephants. This document is intended to be a practical and comprehensive reference tool for veterinarians, mahouts, forest officials, and elephant handlers involved in the daily management of captive elephants. It outlines routine and preventive foot care practices, provides guidance on the identification and treatment of common foot conditions, and introduces the proper use of instruments and materials required for foot examination, trimming, cleaning, and therapeutic interventions.

The primary aim of this manual is to equip field-level personnel with scientifically validated techniques and step-by-step protocols to ensure timely detection and management of foot-related issues. This publication is the result of collaborative efforts by domain experts, experienced field veterinarians, and technical staff under Project Elephant. I would like to extend my appreciation to the contributing authors, reviewers, and the Wildlife Institute of India for their valuable inputs. I also urge all field personnel and institutions involved in captive elephant care to utilize this manual as a practical guide and standard reference, and to incorporate its principles into their day-to-day management practices. I am confident that this manual will serve as a useful resource in further strengthening the institutional response towards improving the health and welfare of captive elephants in India.

(Ramesh Pandey)

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Azadi Ka Amrit Mahotsav

FOREWORD

Wildlife management is inherently challenging. In particular, when wild animals are maintained in captivity, the challenges increase manifold as captive conditions deprive socializing opportunities and expression of natural behaviors. Such deprivation could result in compromised health manifesting in range of ailments and illness. Captive elephants maintained under human care seem to suffer from range of welfare issues and prominent among them is the foot-related problems.

Such problems often arise due to inadequate or poor understanding of species biology. For elephants, foot problems can be debilitating causing life-long suffering and trauma. Unfortunately, foot problems in elephants are extremely challenging to address given their massive weight and anatomical complications. Thus, prevention is better than cure. This being the case, it is also a reality that frontline personnel engaged in captive elephant management seldom understand complex nuances of elephant foot for timely interventions. The absence of standardized protocols, variation in local practices, and shortage of trained personnel has hindered effective foot care. Thus, a ready reference manual is an essential first step in advancing captive elephant foot health. To address this, Project Elephant and the Wildlife Institute of India have developed a dedicated document on foot care for captive Asian elephants. This document showcases the collaborative effort of experts from across the country, pooling their expertise to advance captive elephant well-being with special reference to elephant foot care.

This document provides a valuable resource for field veterinarians, forest officials, and mahouts, covering essential aspects such as routine foot inspection, trimming procedures, and management of common foot ailments. It also addresses enclosure flooring, hygiene maintenance, and skill development.

By bridging the gap between field realities and veterinary best practices, this initiative aligns with Project Elephant's objectives of strengthening welfare standards and promoting evidence-based management.

I'm confident that this document will improve the care and management of captive elephants, enhancing their welfare and health outcomes. I congratulate Project Elephant and the Wildlife Institute of India on this important initiative.

(Gobind Sagar Bhardwaj)
Director
Wildlife Institute of India

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PREFACE

The long-term well-being and optimal management of captive Asian elephants rests on ensuring the highest standards of care and husbandry. Among the various components of elephant health, *foot care* stands out as one of the most critical, yet often under-emphasized, aspects of captive management. Given that elephants in captivity are exposed to artificial substrates, limited movement, and altered foraging behaviour, their feet are particularly vulnerable to a range of ailments that can significantly impact their health, comfort, and longevity.

Foot problems are among the leading causes of morbidity in captive elephants across the globe. Conditions such as abscesses, cracks, foot rot, arthritis, and even fatal infections often result from a combination of poor hygiene, inadequate trimming practices, unsuitable substrates, and lack of routine inspection. Addressing these challenges calls for a well-informed, collaborative approach involving veterinarians, mahouts, animal handlers, and facility managers. Recognizing this urgent need, Project Elephant, in collaboration with expert veterinarians, field practitioners, and technical partners, has developed this document **"Healthy Feet, Healthy Elephants: A Comprehensive Guide to Foot Care in Captive Asian Elephants."** This is the first structured attempt to provide science-based, field-friendly, and context-specific guidance for zoo professionals, sanctuary staff, mahouts, and veterinarians who are engaged in the daily care and management of captive elephants.

The guide comprises seven structured chapters beginning with the biological and anatomical foundations of elephant feet, moving through the implications of diet and substrate on foot health, and offering practical, hands-on instructions for foot inspection, trimming, treatment, and prevention. The manual ends with templates for foot care records and a glossary of terms. This document is meant to be both a quick reference and a training resource that encourages regular, preventive foot care instead of waiting to treat problems after they occur. It reflects the determined efforts of a committed technical drafting team, with contributions from veterinary experts and experienced field personnel. Their insights and on-ground experience have shaped this comprehensive yet accessible manual.

We are confident that this guide will support and empower field teams to adopt more informed, preventive, and welfare-oriented foot care practices. A sound foot care routine not only ensures better health outcomes for elephants but also strengthens the human-elephant bond through daily positive interactions.

We sincerely thank all the contributors for their dedication and valuable efforts in making this important manual a reality. We urge all institutions and field personnel managing captive elephants to make the best possible use of this guide in their respective setups.

Because healthy feet mean healthier elephants; let us take a step forward in improving the lives of these magnificent animals.

Editors (s)

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CHAPTER I
INTRODUCTION

CHAPTER I
INTRODUCTION

Asian elephants (elephants henceforth unless specified otherwise), revered for their deep-rooted cultural significance and intelligence, face significant welfare challenges in captivity. Among the myriad challenges facing the welfare of elephants, foot-related problems are overriding, often debilitating and thus, seriously undermine the quality of life in captivity. Elephant feet have evolved to bear its enormous body weight and specifically adapted for long-distance movement in tough terrain. The need for pronounced weight-bearing, high mobility and durability makes the foot anatomy inherently delicate and complex. In wild habitats, natural substrates such as soil, mud, sand, and water bodies help maintain optimal foot condition. However, in captivity, elephants are often confined to restricted spaces with hard or artificial substrates that can predispose them to a range of foot ailments. Additionally, **poor housing, inadequate nutrition, lack of routine care and improper management practices often predisposes elephants to a range of foot problems in the captivity. Similarly,** accidentally tripping, injuries due to projectile articles (including broken glass pieces), rocks, wooden logs and others are frequent.

Foot disorders such as cracks, abscesses, and nail problems cause immense pain, compromise mobility, alter behaviour and severely impact the overall well-being of elephants. Foot problems in elephants are also difficult to treat as there is continuous weight-bearing pressure on the legs.

Neglecting foot health can lead to chronic pain, increased risk of infections, and even progress into lameness. A healthy elephant foot can be indicative of overall well-being of the animal in captivity as foot health is correlated to optimal weight, better nutritional status, appropriate housing, and desired level of mobility. Therefore, focus on the foot health of the captive elephants assumes priority. By prioritizing foot care, we can significantly enhance the welfare and quality of life of elephants. This sets the context for coming up with a comprehensive, ready-reference manual that elucidates the complexity of elephant foot and approaches to effectively manage it. The manual aims to provide elephant handlers, veterinarians, and elephant managers with the knowledge and tools necessary to prevent, diagnose, and treat foot-related issues in captive elephants. The manual elaborates on the best practices, treatment options, and innovative solutions to promote healthy feet and happy elephants.

1.1. Elephants in Captivity: Keeping of elephants in captivity in India is an age old practice. Elephants captured from the wild were trained and used for various kinds of activities. Since long, the captive elephants were predominantly used in temples and also in wars till modern arms and armaments came into being replacing elephants. The captive elephants were also extensively used for forestry operations such as timber extraction and hunting. At present, the state Forest Departments in India maintain elephants in the camps for patrolling difficult terrain and also for eco-tourism purposes. In the forest camps, the captive elephants often spend considerable time in the forested environments where foot and other health problems get naturally minimized. However, more than three quarters of the captive population are still in temples and rescue centres. These elephants do not get sufficient exercise, and are also housed in enclosures with improper substrates. They are fed processed food, which may be deficient in nutrient that is essential for the foot health of elephants (e.g. Biotin- Vitamin B-7). Consequently, the elephants suffer from various foot ailments and infections. For addressing this concern, a study was carried out based on 312 randomly selected captive elephants during 2003-2005, 14 different kinds of foot ailments were observed, which affected nearly 50% of the sampled elephants (Sarma *et al*. 2012). Csuti *et al*., (2001) made a similar observation by suggesting that over 50% of the

observed captive elephants suffered from foot-related ailments. Common foot problems include overgrown toenails, cracked pads, abscesses, solar ulcers, arthritis, and diversity of infections. If not addressed promptly, they can cause chronic pain, mobility limitations, behavioural issues, and even systemic illness. Therefore, regular and preventive foot care is not only a welfare imperative but also critical for the longevity, productivity, and humane treatment of captive elephants.

1.2. Importance of Foot Care in Captive Elephants: The foot of an elephant is a highly evolved appendage that not only supports the enormous weight but can also withstand massive concussion. While the anatomical structure of the foot is eminently suited for elephants in the wilderness; in captivity foot diseases probably constitute the most numerous and potentially damaging of ailments that causes increased morbidity and mortality.

1.3. Purpose and Scope of the Manual: This document provides a comprehensive and practical resource for improving foot health in captive elephants housed in diverse facilities, including zoos, forest camps, rescue and rehabilitation centres, temples, sanctuaries, and private ownership settings. Drawing on national and international best practices, veterinary expertise, and traditional knowledge systems, it offers evidence-based strategies to prevent, diagnose, and manage foot disorders in elephants. The key areas addressed are:

- Anatomy and physiology of elephant feet
- Role of nutrition and substrates in determining foot health
- Common foot problems and their management
- Preventive practices, foot care tools, and hygiene protocols
- Contributions of caregivers and facility design for well being

The guideline also touches upon practical field challenges and discusses solutions tailored to Indian conditions and field-level realities.

1.4. Target Audience: This guideline is designed for a broad spectrum of stakeholders including professionals engaged in the care and management of captive elephants. These include zoo professionals, curatorial staff, veterinary officers, forest department personnel, mahouts and elephant handlers engaged in the care and upkeep of elephants. It also addresses the needs of animal keepers and handlers in sanctuaries, temples, and privately managed facilities, as well as NGOs, wildlife researchers, veterinary and natural science students, and training institutions involved in **scientific** r**esearch and** capacity building. By catering to both technical experts and frontline **elephant handlers**, the **manual** aims to promote a standard **approaches in** foot care **management** across **in India**.

Overall, by integrating science, traditional knowledge, and field realities, and fostering collaboration among veterinarians, mahouts, and facility managers, the manual is intended to advance humane and sustainable approaches to elephant management.

1.5. The Role of Veterinarians, Mahouts, and Animal Handlers in Foot Care: Foot care in elephants requires a coordinated, team-based approach. The roles and responsibilities of key personnel are outlined as follows:

- Veterinarians are responsible for diagnosing and treating foot conditions, developing preventive care plans, training staff in techniques essential for elephant management, and overseeing/executing medical procedures. They also guide decisions on environmental modifications and specialized treatments and suggesting helpful substrate lay outs.
- Mahouts and animal handlers form the first line of care. With their daily, close proximity to the elephants, they are ideally positioned to detect early signs of foot distress, carry out routine cleaning and trimming, and implement veterinary instructions with patience and consistency.

- Facility managers and supervisors ensure resources, compliance with protocols, infrastructure support, and periodic documentation, facilitating a safe and welfare-centric environment for both elephants and handlers.

CHAPTER II
KNOWING ELEPHANT FOOT

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KNOWING ELEPHANT FOOT

Elephants have evolved graviportality locomotion with legs acting as pillars to support their enormous body weight and also enable sustained long-distance mobility. Elephant feet are unique and it is seldom possible to make easy comparisons while diagnosing and treating foot-related ailments.

About Elephant Foot:

- The foot has an integumentary covering consisting of skin, toenails, and a cornified but flexible sole (slipper)
- Asian elephants usually have five toenails on each front foot and four on the rear foot. Toenails do not bear weight and each of it grows approximately 0.5 to 1 cm per month.
- Each toenail has a cuticle or eponychium. Few sweat glands are located just above the cuticle.
- Sole (also known as footpad or slipper) is the bottom of the elephant foot characterized by a flexible, keratinized layer overlying a germinal epithelium and corium.
- The footpad has a fatty digital cushion – an extensive fibro elastic structure surrounded by digits on the cranial and lateral aspects of the foot, that provides a good grip while walking and improves blood circulation throughout the body.

Knowledge about unique anatomy of the elephant foot is of paramount importance for foot care.

2.1. Anatomy of the forefoot

The elephant's foot structure is unique, with the forelegs relatively longer than the hind legs and also in bearing considerably more body weight in a standing position. The forefoot pad is irregularly round, and distinct from the hindfoot pad both in shape and size. The bone arrangement in the elephant's foot bones includes the carpal bones (arranged in two rows), metacarpal bones, and phalanges. The carpal bones in elephants are considerably shortened in comparison to other ungulates.

The foot of the elephant also has specialized cartilaginous structures known as the “prepollex” in the forefoot and “prehallux” in the hindfoot, which help stabilise the bones over the digital cushion. In the elephant forefoot the toes are structured differently –toe #2 to toe #4 in the front foot have three phalanges each, toe #1 have one phalanx, and toe #5 have two phalanges.

2.2 Anatomy of the hindfoot

The hindfoot of the elephant is relatively smaller and oval-shaped compared to the forefoot. The hindfoot is made up of three main bone groups — tarsal bones (ankle bones), metatarsal bones (long bones in the foot), and phalanges (toe bones). The tarsal bones are arranged in three rows, with the talus and calcaneus forming the first row, a single central bone in the second row, and four wedge-shaped bones in the third row that connect to the metatarsal bones.

The hind foot has four toes, with toe #2 to #4 having three bones each and toe # 5 having two bones. Each toe ends with a toenail that's attached to the distal phalanx (toe bone) by a layer of vascularized fibrous tissue called the corium.

2.3 Other aspects of foot anatomy

i. The Laminae

Laminae of foot in elephant are modified vascular tissues, provide strong and flexible attachment between dorsum of P-III and toenails. The laminae is mainly responsible for supplying blood and oxygen to delicate pedal tissues and reducing concussion to the foot.

Fig 2.1: Laminae of the foot in elephant (© KK)

ii The metacarpal and metatarsal bones

The metacarpal and metatarsal bones maintain a relatively vertical angulation during weight bearing but the phalanges compress the digital cushion and lie nearly horizontal when supporting the weight of the body.

2.4. Functions of elephant feet: Elephant feet are specially adapted to support their heavy weight. They walk on their toes (digitigrade) with their front feet and somewhat flat-footed (semi-plantigrade) with their back feet, with the hindfoot often stepping into the print of the forefoot. The legs are straight and the articular surfaces are in line with the axis of the leg. Elephants cannot jump due to the almost vertical orientation of their limb bones. The limbs avoid excess exertion by flexing minimally during locomotion. The appendicular skeleton of an elephant is articulated in such a way that sideways and backward movements are very much restricted. Elephant limb bones are massive and lack a marrow cavity which is replaced with a dense network of cancellous bones making the bone much stronger. While at rest elephants may sway moving back and forth to alternate the weight between legs. This is not an aberrant behavior but a natural one and it facilitates the circulation of blood from distal extremities back to the heart. Elephants use their feet along with its trunk during foraging by scraping the grass from ground, scalping the mud from grasses, crushing succulent items and for manipulating the tree fodders while feeding. Elephants also use their feet for scraping soil during dusting and mud bathing. Mechanoreceptors in toes and foot pads are known to be helpful in detection of ground vibrations.

2.5. Blood circulation and thermoregulation

Digital cushion in the foot of the elephant functions as a peripheral pump to force blood up the leg. In an adult elephant bearing its own weight, the circumference of the foot just above the nail increases up to 11 cm. During this process, the digital cushion compresses and pushes peripherally, causing an increase in circumference and compressing the veins in the foot by pushing the blood up the leg. This peripheral pumping facilitates regular flow of blood from periphery to heart and hence to ear and other parts of the body where blood is cooled down by convection and helps in thermoregulation.

Sweat glands present at the coronary band area opens just over the upper border of the toenails. One can easily see the wet coronary band area in an elephant coming from a walk during the summer. These glands and their secretions maintain thermoregulation of the feet and prevent brittleness of the toenails from over desiccations in a very dry substrate and dry weather. Brittleness may lead to splitting of the

toenails at the free border. Overgrown cuticles may obstruct outflow of sweat aggravating the condition; therefore, periodical trimming of the cuticles is necessary.

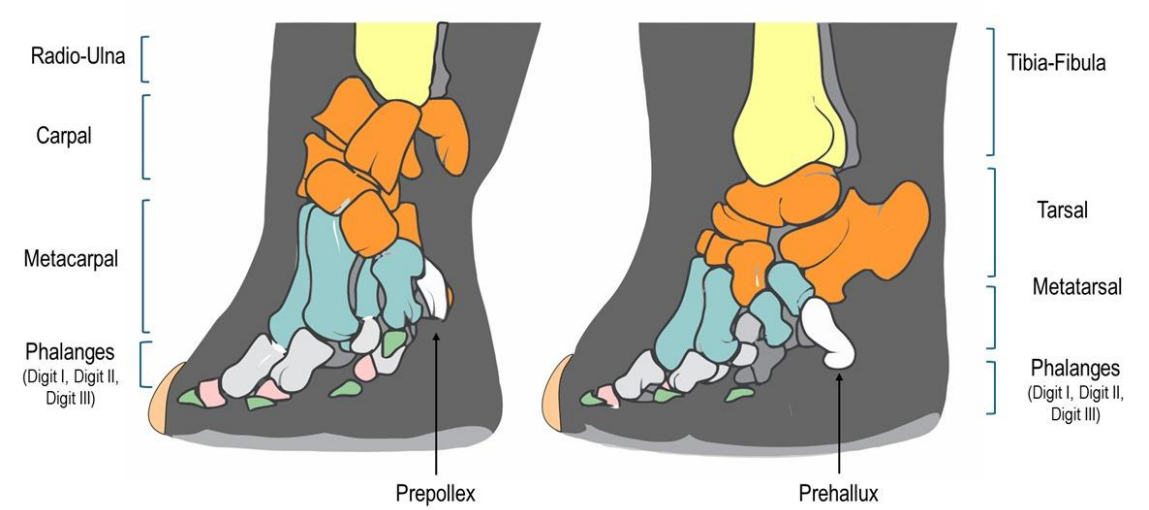

Fig 2.2: Schematic diagram of the elephant foot showing ankle and pad assemblage. [Adapted and modified from Ed Young, 2011].

Ideal Foot Characteristics

Foot structure

- Sole (pad): Thick, elastic, and keratinized; free from cracks, overgrowth, or foreign bodies.
- Toenails: Smooth, well-trimmed (naturally or via management), no cracks, overgrowth, or infection.
- Cuticle line: Should be clearly visible and not overgrown.
- Interdigital spaces: Clean, dry, and free from foul odor or necrosis.
- No signs of lameness or asymmetry in gait or weight-bearing.

Anatomical integrity

- The cushion-like digital pad helps in shock absorption and should show no signs of inflammation or abscess.
- Good hoof conformation with the weight evenly distributed.
- Healthy sole tissue is pliable but firm.

Clinical signs

- No swelling, discharge, ulceration, or foul smell.
- No signs of pododermatitis, sole abscess, osteomyelitis, or cracked nails.

Behavioral indicators

- Normal stance and posture, with the elephant bearing weight on all four limbs.
- No shifting of weight repeatedly or signs of pain.

2.6. Ideal Foot

Ideal elephant feet in captive conditions should exhibit key characteristics, including well-shaped, flat, and evenly formed footpads without overgrowth or cracking, smooth toenail surfaces that are trimmed and free from cracking or splitting, healthy skin with no cracks, fissures, or lesions, good foot conformation with well-aligned and symmetrical feet, adequate cushioning and elasticity in the footpads for shock absorption, and no signs of pain or discomfort while walking or standing. Additionally, the elephant's

weight should be evenly distributed across all four feet without favouring any one foot, and the feet should be free from signs of infection or inflammation, such as swelling, redness, or discharge, ensuring the elephant's overall comfort and mobility.

Fig .2.3: Well-maintained elephant foot with sufficient space between the nails (© IS & PN)

Fig 2.4: Well-maintained toenail of forest camp elephant. (The surface of the toenails may not be smooth as the nails are constantly used during grazing, scalping and manipulating stems, barks, tree fodders in the wild during feeding) (© Dr Rajesh Kumar)/ Healthy sole of forest camp elephant with uniform wear. (No overgrowth or pocket formation for accumulation of debris and infection) (© RK)

The elephant foot is a complex structure that plays a crucial role in supporting the animal's massive weight and facilitating movement. Understanding the unique anatomy of the elephant foot is essential for providing proper care and management. The foot consists of a digital cushion, bones, and soft tissues that work together to absorb shock and distribute pressure. The forefoot and hindfoot have distinct shapes and structures, with the forefoot bearing more weight. The foot also has a specialized system for blood circulation and thermoregulation, with sweat glands and a digital cushion that helps to pump blood back up the leg. An ideal elephant foot should have well-shaped pads, smooth toenails, and healthy skin, with no signs of pain or discomfort. Proper care and management of elephant feet are critical to preventing foot ailments and ensuring the overall health and well-being of these animals.

CHAPTER III
THE ROLE OF NUTRITION IN MAINTAINING FOOT HEALTH IN ELEPHANTS

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In captivity, a range of foot-related problems are seen in elephants. Nail cracks, sole overgrowth, abscesses, and pododermatitis are amongst the most common chronic ailments, often resulting in pain, lameness, and reduced mobility. While the role of environmental, behavioural, and husbandry factors in determining foot health are well-recognized, the role of nutrition is often underemphasized. Optimal dietary management and evidence-based supplementation are thus vital for supporting the structural and functional integrity of the elephant's foot.

3.1. Key nutritional factors determining foot health: Elephants require a nutritionally balanced diet to maintain integumentary and musculoskeletal health, including the specialized keratinized tissues of the feet. The influence of nutrition on foot health manifests primarily through its effects on keratin production, skin integrity, connective tissue strength, immune function, and wound healing. Key nutritional factors that determine foot health of elephants include the following:

i. Protein: High-quality dietary protein supports keratin synthesis and tissue regeneration. Inadequate protein intake can impair hoof wall and sole development, leading to brittle nails and delayed healing of foot lesions.

ii. Trace minerals

- **Zinc:** Essential for keratinocyte proliferation, epithelial integrity, and immune defence. Zinc deficiency in elephants can contribute to hyperkeratosis, poor sole and nail quality, and reduced resistance to infection.
- **Copper:** Required for connective tissue strength through its role in collagen and elastin cross-linking. Copper deficiency may predispose elephants to weakened foot pads and joint issues.
- **Selenium:** Functions as a key antioxidant in synergy with Vitamin E. While critical for tissue repair and immune function, excess selenium can be toxic and should be carefully managed.

iii. Vitamins

- **Biotin (Vitamin B7):** Plays a pivotal role in keratin metabolism. Biotin deficiency can be linked to poor nail formation and issues of cracking.
- **Vitamin A:** Supports epithelial health and immune function. A deficiency can impair skin resilience and thus, increase the risk of secondary foot infections.
- **Vitamin E:** Acts as an antioxidant that protects foot tissues from oxidative stress and aids in the healing of chronic wounds.

iv. Essential fatty acids: Omega-3 and omega-6 fatty acids are involved in modulating inflammation and maintaining skin barrier function. Inadequate intake can compromise dermal health and slow recovery from foot injuries.

Nutrient requirements expressed per unit of metabolic body size (body weight in kg$^{0.73}$)
(adapted as such from Ajitkumar et al., 2009)

Nutrient	Adult elephant (2500 to 6000 kg)	Growing elephant (500 t0 3500)
DM (dry matter)	0.108 kg	0.142 kg
DCP (Digestible crude protein)	0.006 kg	0.007 kg
TDN (Total digestible nutrients)	0.058 kg	0.070 kg
DE (Digestable energy)	278 Kcal	335 Kcal
ME (Metabolisable energy)	237 Kcal	279 Kcal
Ca (Calcium)	0.005 kg	0.006 kg

3.2. Effect of body condition on foot health: While malnutrition can affect foot health through impoverished essential nutrients, overfeeding, particularly of calorie-dense diets, can lead to obesity in captive elephants. Obesity would increase mechanical stress on the feet, exacerbating pressure-related lesions and impairing healing capacity. In captivity, the combination of nutrient deficiency and obesity related to calorie rich diet often result in compromised foot conditions for elephants.

3.3. Impact of diet in captive settings: In the wild, elephants forage on a wide variety of vegetation, which typically supplies sufficient minerals and vitamins. However, in captivity, diets based on restricted forage, commercial pellets, and local vegetation may lead to nutritional imbalances. Deficiencies in zinc, copper, and biotin are commonly observed and directly correlate with poor foot and skin health. Additionally, lack of dietary diversity and improper roughage-to-concentrate ratios can influence keratin metabolism and hoof horn strength.

3.4. Nutritional supplements to maintain foot health in captivity: To minimize the nutritional deficiencies that affect foot health in captive elephants, dietary supplementation is often necessary. Supplements should be based on individual assessments, including dietary analysis, clinical evaluation, and laboratory diagnostics. The following are to be considered while planning nutritional supplements.

i. Comprehensive assessment prior to supplementation: Initiate supplementation after carrying out comprehensive nutritional analysis and veterinary consultation. For this purpose, evaluating serum trace minerals and vitamin levels would be useful.
ii. Formulation and dosing: Supplements should be tailored to the individual's age, body weight, diet, and clinical status. Use of palatable formulations mixed with familiar food items (e.g., bananas, rice balls) would be ideal.
iii. Monitoring and adjustments: Foot health outcomes should be monitored over weeks to months. Regular foot examinations, photographic records, and keratin growth rate evaluations help assess efficacy. Adjustments should be made based on observed response and laboratory results.
iv. Integration with foot care protocols: Nutritional supplementation must be part of a holistic foot care strategy that includes regular trimming, foot soaks, substrate enrichment, exercise, and hygiene management to achieve optimal results.

Foot health in elephants is intricately tied to nutritional status. Balanced diets rich in essential proteins, vitamins, and trace minerals are foundational for maintaining the integrity of nails, pads, and skin. In captive management systems where dietary variability is limited, targeted nutritional supplementation particularly of biotin, zinc, copper, selenium, and omega-3 fatty acids can significantly improve foot resilience, promote healing of chronic lesions, and reduce the incidence of debilitating foot diseases. An integrated approach combining nutrition, preventive foot care, and environmental management remains the cornerstone of effective foot health maintenance in elephants.

CHAPTER IV

ROLE OF SUBSTRATE IN FOOT HEALTH

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While foot-related problems are seldom seen in wild elephants, they constitute one of the major concerns facing elephants that are in confinement and captivity. In the wild, elephants are constantly moving across various types of terrain, from forest floors to grasslands, riverbeds, often walking for miles each day. This constant movement over natural substrates helps maintain foot health. However, captive elephants, whether in zoos, and sanctuaries, may face more limited environments, often confined to artificial surfaces that do not mimic the conditions found in their natural habitats.

Elephant feet are large, anatomically complex, and thus, extremely challenging to manage should chronic problems arise.. Therefore, preventive care and maintenance are pertinent. Among the myriad factors affecting captive elephant foot, the substrate has an overarching influence. Here, the role of different substrate types in determining elephant foot health and taking informed decisions in developing an appropriate substrate in the captivity to maintain foot health are elaborated in detail.

4.1. Selecting the right substrate for elephant housing - key considerations: The substrate type whether soil, sand, or concrete may have significant implications for the overall well-being of elephants, including the development of musculoskeletal and skin conditions. A mosaic of substrates keeps a balance between moisture and dryness of the elephant feet.

i. **Providing a variety of substrates for cognitive stimulation**: Allowing elephants to choose from a variety of substrates within their enclosure facilitates exploration, increased physical activity and offer cognitive benefits.
ii. **Ensuring better shock absorption**: An ideal substrate in the captivity would offer a high degree of flexibility and cushioning to distribute elephant's weight evenly thereby reducing localized pressure points. Surfaces like mud, soft soil, or grass provide natural shock absorption.
iii. **Moisture regulation:** Substrate with better breathability can be useful in regulating moisture levels important for keeping the foot pads from becoming too dry or sodden. Dry substrates lead to cracks in the foot pads and brittleness in the toenails while damp substrate promote bacterial or fungal infections, such as foot rot. Thus, ensuring proper drainage in enclosures is critical for promoting respiratory, skin, and foot health. Soft substrates, such as sand, function as a "bio floor," facilitating urine drainage.
iv. **Providing appropriate traction:** Being large and heavy elephant feet require sufficient traction while moving to prevent slipping and tripping. An appropriate substrate will provide enough grip for the elephant to walk, run, or turn without excessive strain. Surfaces like mud or sand provide traction without being too abrasive, while hard surfaces like concrete can cause wear on the foot pads and toenails over time. Presence of too many sharp pebbles in the substrate is detrimental to elephant foot.
v. **Sustaining optimal skin condition:** Dust and mud baths are crucial for elephants in temperature regulation, protecting against sunburn, and promoting skin health by preventing parasites and moisture loss. These baths also support natural behaviours, enhancing both physical and psychological well-being. Providing appropriate substrates for dust and mud bathing is thus essential for maintaining elephant health and welfare in captivity.

4.**2. Flooring options:** In the wild, elephants typically walk on varied substrates like sand, loose soil, marsh, bog, water, mud, rocks, and grassy glades. They also use shady forest tracks, trails and even

roads adorned with trees. These substrates provide natural cushioning, absorb shock during swift movement in uneven terrain minimizing strain on the joints. These natural surfaces also enable balanced weight distribution and thus equalizes pressure on the individual foot. Therefore, ensuring natural surfaces (i.e. those that are not concretized, metalled or cemented) is important to improve overall foot health of elephants. It may also be noted that walking on loose soil may sometimes result in accumulation of fine particles between the toes, which need to be monitored and cleaned regularly to prevent abrasions. Soft substrates also allow elephants to dig, which is a good workout that strengthen the limb muscles, tendons, and joints supporting healthy feet throughout the elephant's life in the captivity.

Fig 4.1: Outdoor area with appropriate environments to accommodate an array of locomotor and foraging behaviours

4.2.1 Concrete floors: Concrete floors are most common substrates found in captive conditions as they are durable and easy to clean. Despite its wider utility, there are many concerns that can seriously undermine elephant foot in concrete substrates. Some of the major challenges include:

a. Prolonged exposure to concrete can lead to wear on the elephant's feet, especially if the surface is not maintained with soft bedding.
b. Concrete can cause joint stress, pressure sores, and even foot infections if not properly managed.
c. The constant impact of walking on concrete can lead to the hardening of foot pads and the formation of cracks, which increase the risk of infection.
d. Concrete surfaces can become very hot, especially in hot climates. The high temperature can lead to burns on the soft pads of an elephant's feet, which can cause pain, blisters, and infections.
e. Regular long walks in concrete or tarred road can cause serious wear of the foot pad making it thin, which may force the elephant to suffer in the hot surface. This may also lead to solar ulcer, abscess and higher incidences of picked up thorn/nail.

While concrete floors are certainly not desirable, wherever these floors are currently used, it must be ensured to clear and disinfect the substrate regularly. It should provide drainage to avoid pooling of urine.

Fig 4.2: Elephant standing on Concrete floor.

4.2.2 Synthetic tiles, granite, mosaic and marble flooring: These are rarely used in enclosures. These slippery substrates are totally inimical for elephant foot and thus, should be avoided. It is important to avoid/prevent elephants from walking any of these substrates even for short distances.

ii. **Synthetic matting:** Rubber mats with textured surface are designed to replicate the feel of natural ground and provide uniform support and high level of cushioning that reduces the

Fig 4.3. Textured rubber mats to reduce impact on feet and joints

impact forces on feet and joints. Well-maintained rubber mats can provide a non-slip surface, reducing the risk of falls.

4.2.3. Improvisation of the substrate:

***i. Additional bedding support*:**
Providing suitable bedding materials inside enclosures is crucial for elephant foot care. Soft, breathable materials like hay, straw, or sawdust can reduce pressure on the feet and absorb moisture, preventing infections. Regular cleaning and replacement of bedding are essential to prevent bacterial buildup. The ideal bedding depth should cushion the feet without causing instability.

Fig 4.4. Enclosure layered with soft hay for cushioning.

ii. Ploughing: Ploughing in elephant enclosures can be useful for elephants in many ways.. It is used to turn and aerate the soil preventing the enclosure from becoming muddy. Ploughing can also be helpful in managing the overall drainage thereby preventing excessive wetness and water stagnation which could cause foot infections of long-term concern..

Fig 4.5. Enriching soil structure through ploughing

4.3 Salient Points

- The housing and enclosure design for captive elephants should be designed keeping in view the animal ‘s basic requirement and behaviour. The enclosure should provide adequate space for free and natural movement and have proper shelter to protect them from adverse weather conditions.
- The floor should preferably be made of natural substrate such as sand or tightly packed earth (earthen flooring) instead of the hard-cemented floors.
- River sand is ideal for the substrate. Sand processed from decomposed granite is best avoided because of the sharp edges (Harald et al.,2001)
- For earthen flooring it is necessary to keep it dry by spreading sand as extended exposure to moist and wet conditions may also result in foot rot condition.
- Hard flooring, despite its hazardous effects on elephant feet may be judiciously used in addition to the natural flooring for occasional night shelters during excessive rains and also during veterinary interventions.
- It is important to house elephants for much of the day on resilient, interactive, yielding surfaces made of natural substrates to enhance natural behaviour.
- The housing should be built on a level area with mild inclination for draining water and urine. However, extreme caution to be taken in ensuring floor designs do not have high degree of slope,

as it will affect weight bearing balance on the sole and nails and further resulting in uneven wear and tear, joint illness on dependent parts, besides causing nail and foot pad ailments

- Floor should neither be slippery not hard.
- Housing should be well ventilated to allow aeration and sun light to keep it clean and dry all the time.
- The tethering area should be carefully selected on a high, well-drained ground to ensure proper drainage and hygiene
- Providing a mud bath area is desirable particularly in areas that lack natural vegetation. In the wild elephants spend considerable time walking through the moist areas. The moisture in natural habitats does not result in decay of foot pad, but can act as a conditioner softening dry areas and keeping the pad healthy. This keeps the nails and pad moist and prevent cracks.
- Practice of making the elephant to stand for long hours in temple premises on hard surfaces in the name of blessing devotees should be avoided.

The substrate in an elephant shelter is a critical determinant of their overall health in general and foot health in particular. By providing diverse natural and other appropriate substrates, injuries and foot deformities can be minimized. It is imperative that in the confined environs such as the zoos, elephant camp facilities, rescue and rehabilitation centres, private facilities, and religious places substrate selection and maintenance are provided emphasize so that needless trauma to elephant foot, which seriously affect their overall quality of life can largely be minimized.

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CHAPTER V

FOOT PROBLEMS AND THEIR MANAGEMENT

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FOOT PROBLEMS AND THEIR MANAGEMENT

Captive elephants are susceptible to various foot ailments due to a range of compromises and challenges, significantly impacting their quality of life. Foot care is a pressing concern in elephant captivity, with issues widely reported across India. The incidence of foot problems often correlates with substrate conditions and management practices. Despite the prevalence of foot-related issues, a comprehensive and focused approach to understanding and addressing these problems remains lacking. Inadequate management and pedicure practices can lead to chronic issues like elongated toenails and painful splits, causing lifelong distress for these animals. This discussion highlights common elephant foot issues, their causes, risk factors, and treatment options, aiming to improve the care and welfare of captive elephants.

5.1. Common foot issues in elephants: Commonly observed foot issues for elephants living in captivity/confinement are as follows.

i. *Overgrown nails:* Toenails become oddly shaped and roughened having a layered appearance. They may extend 12 to 15 cm beyond the foot level. Neglected toenails tend to become infected, deformed, or grow sideways, penetrating the adjacent skin or sole.

Fig 5.1. Overgrown toenails and interdigital fibroma. The condition may have developed due to chronic laminitis. Note the bands/rings in the toenails. (© KK)

Overgrown nails result from lack of wear owing to inadequate exercise and wet substrate conditions. Chronic laminitis conditions with an inflammatory reaction at the coronary band can also result in overgrowth of toenails. Because of overgrown toenails, there will be upward pressure at the coronary band area which obstructs blood flow to the laminas and eventually affects the toenail with other adjoining soft tissues. This is also one compelling cause of toenail pathologies. Toenails grow at a rate of 0.5 to 1.0 cm per month. If the enclosure substrate is not mildly and suitably abrasive, it may be necessary to trim the overgrown nails once in 2-3 months. Corrective toenail trimming may be performed using appropriate equipment and procedure.

Fig 5.2. Overgrown cuticles (© KK)

ii. *Overgrown cuticle:* Overgrown cuticles appear as rough skin over the coronary band, proximal to the nails. In some cases, they also develop between the toes, hindering locomotion and even leading to lameness.

Elephants standing in mud or on their own excrement are vulnerable to developing the problems of overgrown cuticles. The keratinized cuticle hardens and eventually cracks. The overgrown cuticles may obstruct flow of sweat over the coronary band and contribute to disturbed thermoregulation of the toes and development of brittleness. The cuticles should be manicured regularly.

iii. *Cracks and Fissures:* Cracks and fissures often develop in the toe region or along the heel. The intensity of their impact ranges from superficial to deep lesions. While cracks may occur both horizontally and vertically, but the latter are more common. If untreated, they can lead to infection and discomfort.

The etiology is largely unknown but can be attributed to shelter's dry or hard surfaces and further aggravated by nutrition, genetic predisposition, unchecked overgrowth, insufficient foot care, and trauma. Dry substrate condition is also responsible for brittleness as it reduces the elasticity of the horny tissues. Additionally, biotin deficiency is responsible for weakening of toenails.

Fig 2.3. Toenail cracks, A. vertical crack extending up to the coronary band and B. Horizontal crack. The horizontal crack will grow out naturally, but vertical split is difficult to cure if it reaches the coronary band level (© KK)

To treat nail cracks, it is important to trim or rasp the nail to reduce the weight-bearing area near the crack. Ideally, the bottom of the toenail should be at level with the foot pad. Additionally, the crack must be thoroughly cleaned of any necrotic tissue and debris. Moisturizing agents can help prevent cracks.

Suggested intervention: A mixture of oil turpentine (25 Parts), oil eucalyptus (25 parts) and coconut oil/ vaseline (50 parts) can be applied over the coronary band areas during the summer months to improve the elasticity of the toenails

iv. *Toenail abscess:* Nail infections such as the abscesses occur most commonly in elephants. If they are not treated properly and on time, they may impose severe consequences that could even be lethal. Abscesses are commonly the result of some microtrauma to the nails allowing bacteria to invade resulting in necrolytic effects on the nail tissues. Multiple abscesses can form on the same foot and affect several nails, making treatment difficult and time-consuming.

***Fig 5.4. Toenail abscess* (© KK)**

Drainage followed by curetting out necrotic tissues and breaking of the pyogenic membrane would be the essential approach for the therapy addressing abscesses. However, excessive trauma to vascularized tissues should be avoided. Additional treatment would involve drainage and systemic antibiotic therapy. In cases of extensive swelling or cellulitis involving the foot structures, systemic antibiotics are required with anti-inflammatory medications.

Fig 5.5. Improper sole wear and tear (© IS)

v. Abrasion of the sole: The external keratinized layer that forms the flexible sole on the bottom of the elephant's foot is formed by a deep germinal epithelium. Due to excessive wear, thinning of sole occurs. Another predisposing factor is a conformational defect or injury that causes the elephant to walk in a way that leads to excessive wear on a specific part of the slipper. An elephant may also become habituated to pawing with one foot, resulting in excessive wear on the toenail and sole. Hard floor and substrate, foreign body penetration, lacerations are the major causes of sole abrasion.

Fig. 5.6. Affected toenail with inflamed nail bed (© IS)

The other sides of the foot pad should be thoroughly examined for pebbles or thorn/nails. Changing the floor surface, redirecting activities, and using protective devices on the foot, such as applying duct tape repeatedly or using a sandal, can help mitigate the issue.

vi. Onychia: Clinical signs are lameness, a hot painful swelling, or a draining tract at the top of the nail. A severe onychia may cause separation of the nail from the corium with a subsequent slough. This is primarily caused due to poor hygiene and failure to clean behind the toenail.

Fig.5.7. Chronic laminitis causing annular rings in the toenails (© KK)

Clean, dry, soft tethering site with proper drainage and proper periodical foot care along with good nutritional diet with mild exercises is needed to address this condition.

vii. Laminitis: Laminitis is an inflammatory condition affecting the sensitive structures of the foot, leading to pain, lameness, and possible pedal bone rotation. Common causes include nutritional imbalances, excessive carbohydrate intake, and obesity, and rocky substrates.

Proper trimming, low-carbohydrate diet, supplementation of microminerals, and vitamins are essential for managing laminitis.

viii. Erosive/Proliferative Lesions of the Footpad Junction: These lesions occur at the junction between the footpad and the sole, often leading to ulceration or overgrowth of tissue. **Abrasive surfaces and prolonged standing on hard surfaces are common contributing factors.** Soothing creams and regular cleaning are essential for treating these lesions.

Fig. 5.8. Proliferative lesions of the footpad junction. (© IS)

ix. Foot rot: Foot rot is a bacterial infection occurs at sole region exhibits necrotic changes with foul smelling discharge. Poor enclosure design, especially damp environments, is a significant risk factor for foot rot. Treatment involves debridement, antibiotic therapy, and improving drainage in enclosures.

x. Subsolar suppuration: Subsolar suppuration or sinuses has been seen occasionally, which is caused by penetrating pebble or other foreign body carrying infections into the subsolar tissues. This is very painful condition for walking causing severe lameness. Confirmatory diagnosis of the condition is difficult; ultrasonography or thermography can help. Drainage, debridement and antibiotic therapy. The pad tissues should be removed with a hoof knife to expose the infections and pus and necrotic tissues drained out.

Fig. 5.9. Toenail contusion (© IS)

xi. Contusion of toenail/ foot pad: A blow/heavy impact to the surface of the toenail could result in a contusion or hematoma of the laminae. Performing excessive exercise with the elongated toenails could potentially traumatize the nails. Application of ice packs. soaking the feet in cold water to stop extravasation and administration of NSAID may help. Avoid prolonged standing of elephant in hard surfaces.

xii. Solar Ulcers: These appear on the sole of the elephant's foot, typically causing significant pain and difficulty walking. Trauma, over trimming, and infections are common causes of solar ulcers (Kumar et al., 2017). Proper trimming, wound care, and antibiotic applications are crucial for healing. Sole ulcerations linked to digital abnormalities may have a poor prognosis for resolution, even with aggressive treatment (Luikart& Stover 2005).

Fig. 5.10. Ulcerative sole in different stages (©IS)

xiii. Arthritis: Arthritis, or joint inflammation, can significantly affect foot mobility, particularly in older elephants. Arthritis is more prevalent in older elephants, where wear and tear on joints lead to inflammation. Physical inactivity in captivity makes the elephants more prone to gaining weight and developing bone and joint diseases such as osteomyelitis, joint ankylosis and osteoarthritis. Anti-inflammatory drugs and joint health supplements, alongside regular foot care, can help mitigate the effects of arthritis.

xv. Parasitic infections

***a. Cutaneous larva migrans* (CLM)**

This is a parasitic infestation caused by hookworm larvae or other nematodes that penetrates the skin. Elephants often contract CLM through their feet, leading to painful lesions and secondary infections.

Fig. 5. 11. Infections secondary to CLM (© KK)

CLM typically affects the footpad and causes swelling, irritation, and sometimes ulceration in the pad-skin junction or interdigital space. As far as symptoms are concerned, the infection begins with intense itching in the affected part, mostly seen in the interdigital space. The elephant would repeatedly rub the area with the opposite limb. Marked reddening is seen and overtime, the infection gradually grows giving a granulomatous appearance. The infection would continue to grow till it is appropriately treated. The treatment options include use of antiparasitic medications like ivermectin and proper wound care. To prevent CLM in the first place, it is best to avoid walking the elephants on streets where dogs and humans excreta is found. In case of accidental exposure to faecal matter, a proper foot bath with potassium permanganate solution is essential.

b. Myiasis

Many species of blowflies/(bottle flies, family Calliphotidae) may deposit eggs in open wounds of the foot. The larvae fed on exudates and necrotic debris and usually do-little damage, but the larvae are unsightly.

c. Microfilarial dermatitis

Microfilarial dermatitis around the toenail bed and heels of Asian elephants has been ascribed to *Stephanofilaria* sp.in India.

5.2. Photographic Illustrations of Select Foot Disorders

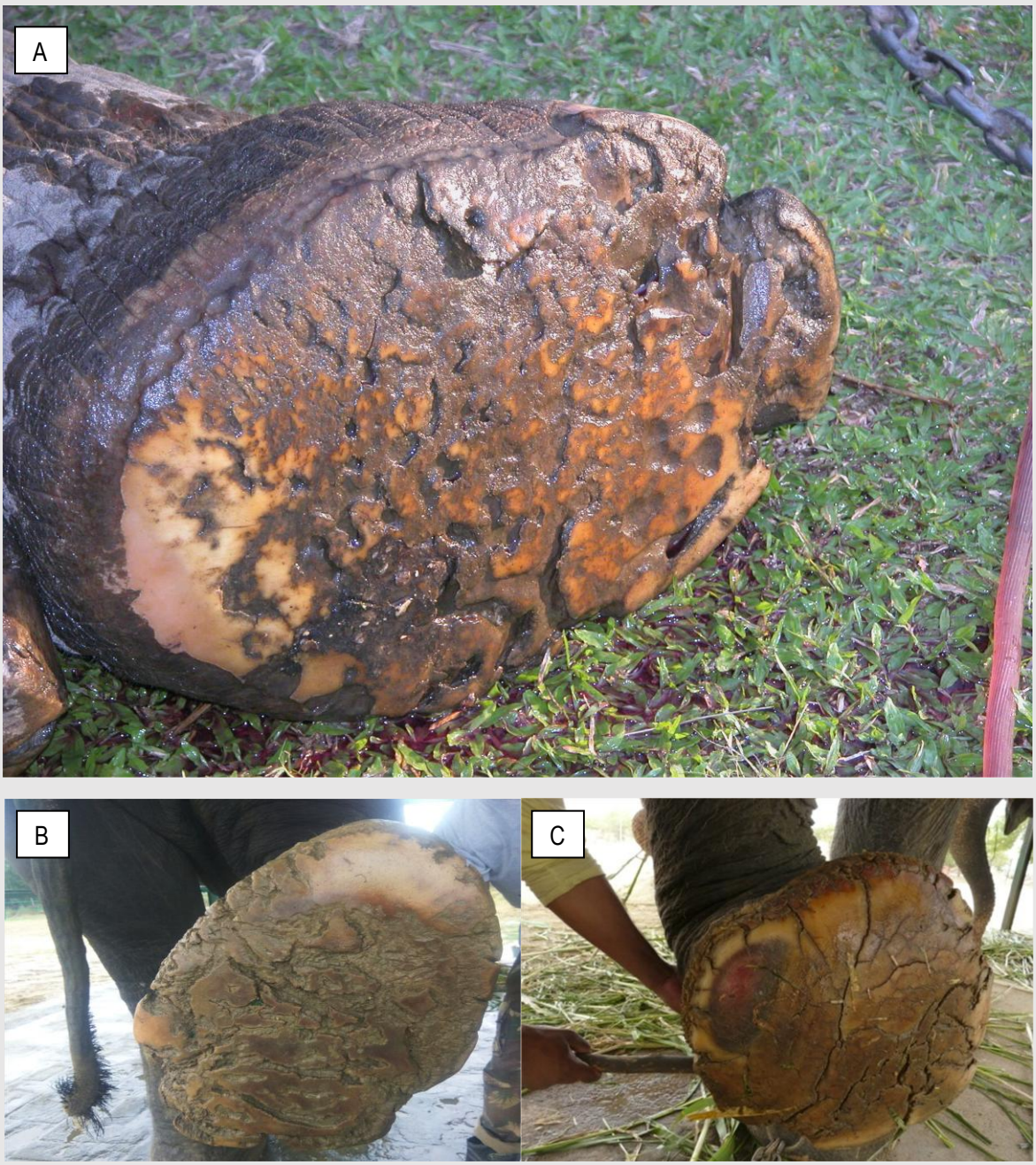

Fig. 5.12. A. Long neglected foot, note double layering of foot pad leading to lodgement of pebbles and coal tar. (© KK) B. Abrasion of sole due to improper weight distribution and C. Leading to severe contusion (© IS)

Fig 5.13: A. Dermatofibroma (Proliferative wart like growth) at nail and coronary band (© GP) B. Cracking of sole and brittleness in extreme dry substrate conditions. (© KK)

Fig. 5.14. A. Separation of foot pad from underlying tissues due to long standing pododermatitis (© KK), B. Severe pododermatitis with brush like edges (© IS) C. Severe diffused pododermatitis affecting sole (© IS)

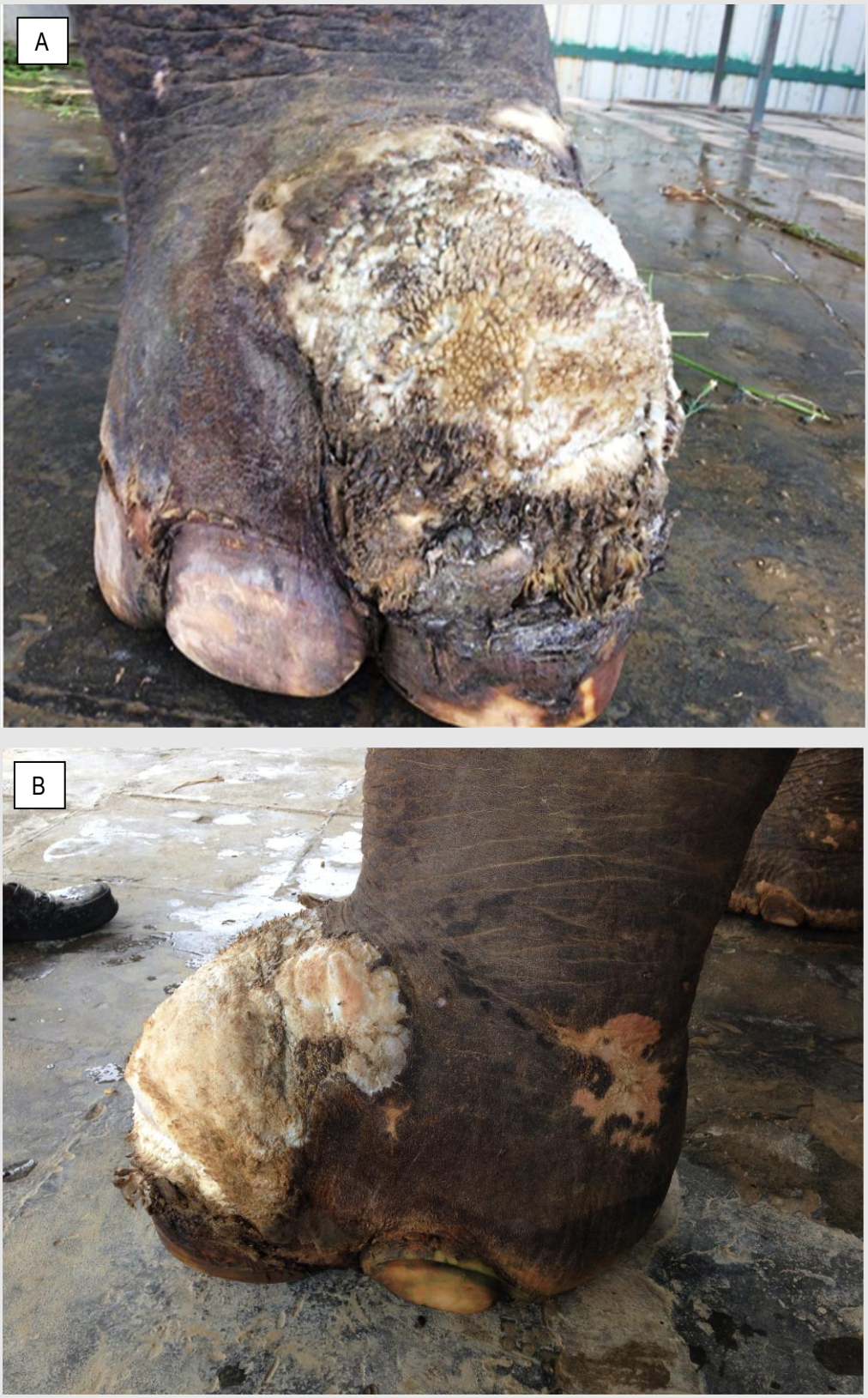

Fig. 5.15. Toenail abscess with severe osteitis and osteolysis on 3rd & 2nd digits (A. Frontal view and B. side view) (© IS)

Fig 5.16. Avulsion of nail due to trauma, and unsanitary conditions, and nutritional deficiencies (© IS)

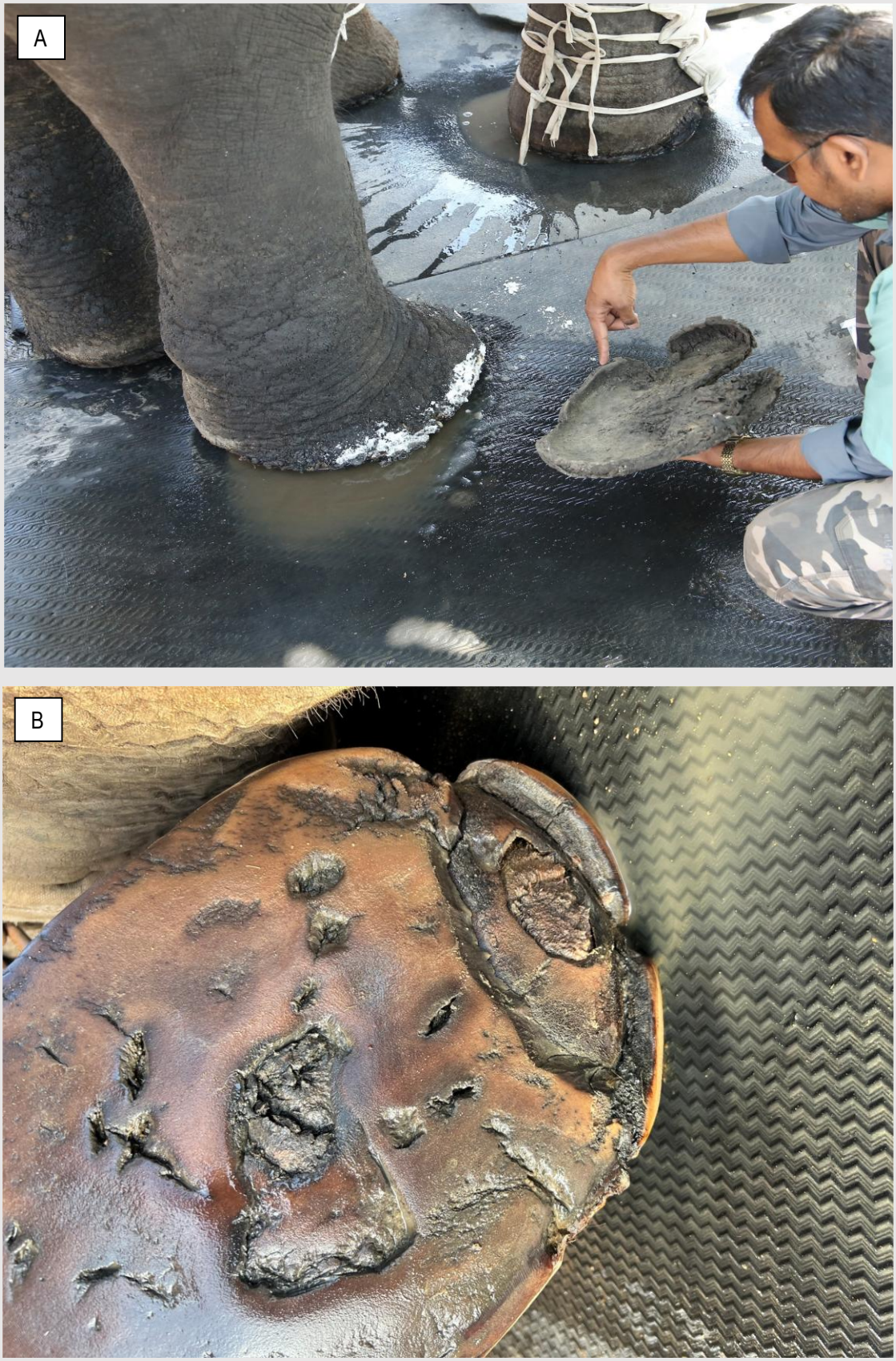

Fig. 5.17 A. Avulsion of sole due to neglected foot care (© IS) B. Drained out sub-solar abscess, sole tissue formation from keratinization of digital cushion. (© KK)

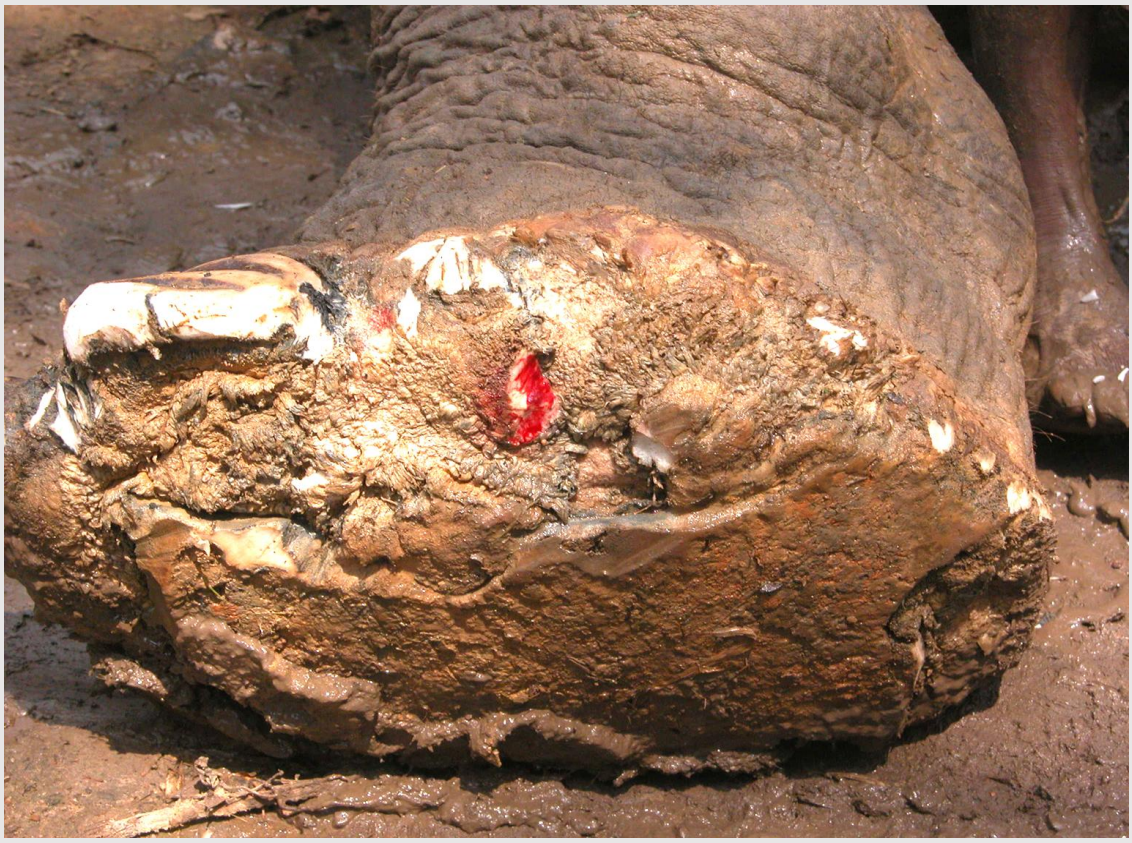

Fig 5.18. Extreme moist substrate leading to erosive type of pododermatitis, sloughing of sole. (© KK)

5.3. Causes and risk factors of concern with respect to elephant foot problems: Foot problems in elephants are often a result of a combination of environmental, physiological, and management-related factors. Identifying and mitigating these risk factors is critical for prevention and treatment. Some of the well-known causes include the following:

i. *Inadequate foot trimming:* Improper or infrequent trimming can lead to overgrown or misaligned toenails, resulting in abnormal weight distribution and increased stress on the feet. Overgrown toenails result in disruption of blood circulation to the sub-toenail areas because of pressure over the coronary band. Consequently, there is gradual weakening of the toenail's horny tissues, which results in toenail splitting from the bottom. Therefore, periodical trimming of toenails of captive elephants is essential. Similarly, when the cuticules over the coronary bands are not trimmed periodically, they may obstruct the flow of sweat. Elephants have sparse sweat gland over their skin and the sweat glands over the coronary band help them to regulate body temperature. Sometimes, interdigital cuticles also overgrow and require to be trimmed, these may affect the sweat flow as well as interfere in expansion and contraction of the digits while walking and standing.

ii. *Poor enclosure design:* Enclosures that lack proper drainage or contain hard, abrasive surfaces can significantly increase the likelihood of developing foot issues like cracks, abscesses, and Infections.

iii. *Nutritional Imbalances:* A diet lacking essential nutrients such as calcium, phosphorus, and vitamins can lead to weak nails, poor skin quality, and increased susceptibility to foot conditions. Biotin (Vitamin B-7) supports many parts of the body including the nervous system, liver, eyes, hair, skin

and nails. It helps the enzymes in the body to carry out their jobs and keeps cells working as they should. It is commonly used to support equine hoof health. It plays a crucial role in keratin production, a key structural protein in the hoof wall. Biotin supplements can potentially improve nail growth rate and, hardness.

iv. *Obesity:* Overweight elephants place excessive pressure on their feet and joints, making them more prone to laminitis, arthritis, and other foot-related issues.

v. *Age:* Relatively older elephants are at higher risk for degenerative joint diseases like arthritis, as well as changes in footpad structure.

vi. Traumatic injury: A traumatic injury to the foot of a elephant can be caused by a vehicular accident and may result in severe damage, including extensive harm to the toenails and footpad. The toenails may be cracked, split, or torn off, exposing the sensitive quick underneath, while the footpad may be bruised, cut, or lacerated, leading to swelling, pain, and risk of infection. Soft tissues surrounding the foot, such as tendons and ligaments, may also be damaged, causing pain and limited mobility. If not properly treated, such injuries can lead to chronic pain, lameness, and long-term damage, impacting the elephant's quality of life and mobility. Prompt veterinary care, including wound management and rehabilitation, is crucial to prevent complications and promote recovery.

Fig. 5.19. Traumatic injury to the foot of a captive elephant caused by a vehicular accident. Note the extensive damage to the toenails and foot pad (© KK)

Fig. 5.20. A. Debridement and dressing B. Protective shoe made of rubber (© KK)

5.4. Diagnosis of foot problems

Diagnosing foot problems in elephants requires a combination of visual inspection, thermography, radiographic analysis, and functional assessments (Ilayaraja & Sha 2022). Some of them are described below:

i. Visual Inspection: Routine visual inspection is essential for identifying early signs of foot problems, such as swelling, discoloration, or abnormal wear patterns.

ii. Radiography: X-rays help diagnose issues such as bone infections, fractures, or arthritis by providing a clear image of the internal structures of the foot.

iii. Thermography: Thermography, or the use of infrared cameras to detect temperature variations, has become a valuable diagnostic tool for identifying foot problems in elephants. The technique works by visualizing differences in thermal patterns, which can indicate inflammation, infection, or stress in the tissues. Hotspots in the foot can signify conditions like abscesses, laminitis, or arthritis, helping to detect issues before they become visibly apparent or cause severe pain.

Fig 5.21. A. Performing radiography of foot and B. thermal imaging of stifle joint (© IS)

Thermography is non-invasive, fast, and can be used alongside other diagnostic methods, such as radiographs, to assess both soft tissue and bone health. Additionally, it allows for early intervention by identifying areas of discomfort that may require further treatment, such as targeted anti-inflammatory therapy or foot care procedures. As it can be used in live animals without stress, thermography represents a promising tool for regular foot health monitoring in captive elephants.

5.5. Treatment options to address footcare concerns

Treatment for elephant foot problems varies depending on the underlying condition but typically includes topical treatments, pain management, and, in severe cases, surgical intervention.

i. Corrective trimming: Corrective toenail and foot pad trimming in elephants is a critical aspect of their healthcare, aimed at maintaining proper foot structure, preventing lameness, and promoting overall mobility. Proper trimming techniques, performed by trained professionals, reduce the risk of injury, improve weight distribution, and contribute to the elephant's long-term well-being and comfort.

Fig. 5.22. Standard procedures for corrective hoof trimming. (a) Sole with excessive growth, showing grooves, ridges, and pockets caused by overgrowth. (b, c) Trimming of cracked edges and overgrown sole (d) Sole after trimming, revealing a smooth, properly shaped surface with improved health and structure. (© IS)

ii. Topical Treatments

Various kinds of topical treatments are also useful in both prevention and cure of different kinds of foot affections. Some of the widely used tropical treatment agents are as follows:

Fig 5. 23. Ethano-veterinary preparation for supporting healing (© IS)

- During the dry season and in dry substrates, the elephant feet should be soaked in clean water at least twice a day.
- A mixture of oil (25% *Eucalyptus* oil, 25% turpentine oil and 50% coconut/mustard oil/white vaseline) could be applied over the coronary region once daily preferably in the evening. Prefence of oil would be determined by local availability. In India, the mustard oil is easily available in the central, north-east, north, and western region, while coconut oil is readily available in the southern region.
- Foot bath with 5-10% formaldehyde solution is useful for pododermatitis. Copper sulphate could also be applied with garlic/turmeric paste in the infected lesions as well as for pododermatitis lesions.

- Antibiotics or antifungals can regularly be applied to infected areas, while protective creams may help treat cracks and lesions.

Elephant foot soles can become dry and cracked, especially in arid climate or if elephant spends lot of time on hard surfaces. After through bathing application of medicated oil "Dekamil Oil" over the foot and nails helps to prevent splits and cracks, strengthening cuticles, prevent excess cuticular growth, act as a fly repellent, act as an antiseptics to prevent foot rot and abscess(Dekamil consist of neem (*Azadirachta indica)* oil-15kg,Camphor (a Terpenoid with aromatic odour)-0.5kg, Garlic (*Allium sativam*)-0.5Kg and Dekamil (Gardenia resin)-0.5Kg) (Ramasubramanium.S et al.,2023).

iii. **Pain Management:** Analgesics and anti-inflammatory medications like NSAIDs are frequently used to manage pain and inflammation.

iv. **Surgical Intervention:** In cases of abscess drainage, nail repair, or severe ulceration, surgical intervention is required to promote healing. These operations may be very painful and best done under deeper sedation and local analgesia.

Fig. 5.24. Foot-care A. Cold fomentation using gel pack to focal area. B. Laser therapy to support healing. C. Medicated foot baths in rubber tubs. D. Cold fomentation for full limb to address multiple inflammatory conditions (© IS)

CHAPTER VI

PREVENTION AND MANAGEMENT OF FOOT DISORDER

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PREVENTION AND MANAGEMENT OF FOOT DISORDER

Foot care problems can be debilitating for elephants resulting in a lifetime of suffering. Yet, treatment for serious foot conditions is often challenging and in some conditions, even impossible. This, preventive foot care is the only judicious option to ensure welfare of elephants in captivity.

6.1 Essential elements of footcare

i Inspection: Foot inspection is an essential aspect of elephant foot care, as it enables early identification of injuries, infections, splitting of toenails, and degenerative conditions. Regular inspection also allows for detection of abnormalities, such as cracks, cuts, picked-up nails/thorns or infections, facilitating timely intervention and preventing the progression of more severe conditions.

ii Cleaning: In order to prevent infections and injury, regular cleaning of elephant feet is essential. Elephants in captivity may accumulate dirt, debris, and waste in their feet, which can lead to bacterial or fungal growth. Routine foot cleaning, using water and cleaning brushes, will aid in removal of foreign particles and contaminants from the interdigital space and the sole, thereby reducing the risk of infections. In addition, cleaning helps maintain proper hygiene and allows for the early detection of potential foot issues.

iii Trimming:

Elephants' nails and other parts of the foot would require periodic trimming to prevent overgrowth, which may lead to biomechanical issues and pain. In the confined environments where movement is highly restricted, manual trimming would be necessary to prevent overgrowth, which could cause pressure sores and even alter gait dynamics. However, professional care would be essential to avoid excessive trimming that could damage sensitive tissues or expose vulnerable structures of the foot.

Fig. 6.1. Water pressure-assisted cleansing of the foot pad to effectively remove contaminants (© IS)

iv. Foot baths

Foot baths act as a preventive and therapeutic intervention to clean and soothe elephant feet, particularly when signs of infection or dryness are observed. Soaking the feet in warm water can soften the skin, cuticles and nails, aiding in the removal of dirt and preventing the formation of cracks. Antiseptic or antimicrobial solutions may also be added to foot baths to prevent or treat infections, particularly in the case of fungal or bacterial diseases. Foot baths also provide hydration to the foot pads, which are susceptible to cracking in dry conditions, thus contributing to overall foot health.

Table 1. Therapeutic solutions for elephant foot soak

Generic Name	*Trade Name*	*Indications*	*Mixing Directions*	*References*
Magnesium sulfate,USP, $Mg\ SO_4\ H_2O$	Epsom salt	A concentrated solution of Epsom salt is hypertonic and draws fluid from tissue; used for local inflammation, cellulitis, arthritis, and contusions	For an elephant foot, 225 g (0.5 lb) of Epsom salt in 2 l (2 quarts) hot water; allow water to cool	Fowler,2007
Chlorhexidine diacetate	Nolvasan solution, 2% chlorhexidine	General disinfectant	250 ml (9 oz) of the 2% stock solution to 1.0 l (1 quart) of clean water = 0.5% chlorhexidine	Fowler, 2007
Copper sulfate	Copper sulfate	Disinfectant, debridement of necrotic and exuberant growths	50 g to 1 liter = 5% solution	Fowler, 2007

6.2. Enclosure considerations

Points for consideration while designing elephant enclosure with respect to foot health are provided below:

i. ***Secure enclosure design:*** Safety is paramount in the design of elephant enclosures. As elephants are large, strong, and intelligent animals, enclosures aimed at confinement and restricted movement should be strong and durable with fencing. The height and strength of the enclosure should be sufficient to prevent elephants from breaching the perimeter. Gates, locks, and other access points must be designed to prevent accidental openings, ensuring that the elephants remain securely confined during management routines or overnight. In addition to structural security, the layout of the enclosure should minimize the risk of injury. Sharp edges, protruding elements, or objects that could cause harm to the elephants should be avoided. Smooth surfaces, rounded corners, and regular maintenance to prevent wear and tear are essential for minimizing the risk of physical harm. In the forest camps, care should be taken to prevent wild bulls from breaking into the enclosure. Wild bulls can confront captive bulls resulting in grievous injuries and even fatalities.

ii. **Cleanliness and hygiene:** Elephants are prone to a variety of infectious diseases and parasitic infestations, which can be exacerbated by unsanitary conditions. Thus, the enclosure must be designed with adequate drainage systems to prevent the accumulation of urine and waste, which can lead to the growth of harmful pathogens, such as bacteria or fungi, and contribute to foot and

skin infections. Frequent cleaning schedules are necessary, with regular removal of waste and soiled bedding materials. A well-maintained enclosure also facilitates the early detection of any potential health issues, such as the presence of abnormal fecal matter, which could indicate gastrointestinal issues, or the identification of foot injuries and infections, which may otherwise go unnoticed.

iii. **Comfort and psychological well-being:** Elephants are intelligent and socially complex animals. Thus, their enclosures must be designed to meet their physical and behavioral needs. Elephants in the wild engage in a range of behaviors, such as foraging, social interaction, and movement across large distances. These natural behaviors should be incorporated into captive environments to ensure psychological and emotional well-being. Thus elephants benefit from enclosures that allow them adequate space for movement, exploration, and social interactions. Additionally, visual barriers or naturalistic elements such as trees, shrubs, or rocks can provide enrichment and promote natural behaviors, reducing stress and enhancing welfare.

iv. **Proper substrate for elephants:** Substrate should provide adequate cushioning to protect the elephants' feet and joints from the hard surfaces of the enclosure. Hard or abrasive surfaces lead to foot problems, such as abrasions, infections, or joint strain, while softer, more forgiving substrates help to mitigate these risks. Deep bedding with materials such as straw or wooden chips can be utilized in resting areas to provide comfort and insulation from the ground. The substrates should also be regularly replaced to maintain hygiene and prevent the buildup of harmful bacteria.

v. **Environmental enrichment and habitat simulation:** Beyond basic hygiene and comfort, it is desirable that enclosures consider environmental enrichment to stimulate the elephants mentally and physically. This may include access to natural features such as pools of water, mud wallows, and climbing structures to promote natural behaviors like bathing and exploration. Elephants are also known to engage in tool use and interacting with objects. Providing a variety of safe objects for manipulation, such as tires, ropes, or logs, can stimulate their cognitive abilities and help alleviate boredom, which is a significant concern in captive environments.

6.3. Nutrition-related considerations

Aspects of elephant nutrition have been elaborated in Chapter-III. The summary of major points pertaining to nutritional needs for optimal elephant foot care are as follows:

- Elephants are generalist herbivores that consume several hundred species of plants in the natural habitats that they live.
- Broadly, elephants' dietary intake comprises grasses, trees, shrubs, leaves, twigs, roots, fruits, seeds and herbaceous plants.
- In the captive conditions, optimizing their diet and providing appropriate supplements would be essential for maintenance, optimal growth, reproductive health, and overall physical condition.
- "Concentrates" (food supplements) should not be fed as the first meal of the day. Concentrates may be fed during noon/afternoon. High moisture feed may be fed any time, particularly during night.
- Elephants are prone to obesity. Thus, body condition should be regularly monitored. Each elephant should be fed individually.
- Growing animals would require relatively high protein and other nutrients.
- Diet for calves may contain 30% of concentrates on dry matter basis, whereas 10% of concentrates in the diet of adult elephant is sufficient of meet nutrient requirements

- While a balanced diet consisting of high-quality forage, fruits, vegetables, and occasional grains can meet the nutritional needs of most elephants, certain supplements may be necessary to address specific deficiencies or health conditions.
- In captivity, mineral supplementation, particularly calcium, phosphorus, iron, copper, cobalt, magnesium, manganese and salt may be essential for foot health.
- Vitamin A, D, and E can be included in the diet of captive elephants to compensate for any deficiencies caused by the lack of exposure to sunlight or a limited natural diet. These vitamins can be provided through fortified feed or direct supplementation.
- The inclusion of probiotics or digestive enzymes may be beneficial in supporting gut health and promoting effective digestion, particularly in elephants with digestive issues. These supplements can help optimize fermentation in the cecum and improve overall nutrient absorption.

Fig. 6.2. Environmental enrichment strategies to encourage foraging and other species-typical behaviour (© IS)

6.4.Physical exercise

Elephants in captivity often have limited space compared to their natural habitats. Regular walks and opportunities for movement are thus essential to prevent obesity and arthritis. Elephant caretakers can take elephants on daily walks around the grounds or allow them to roam large areas. Access to a pool or water source would additionally be beneficial.

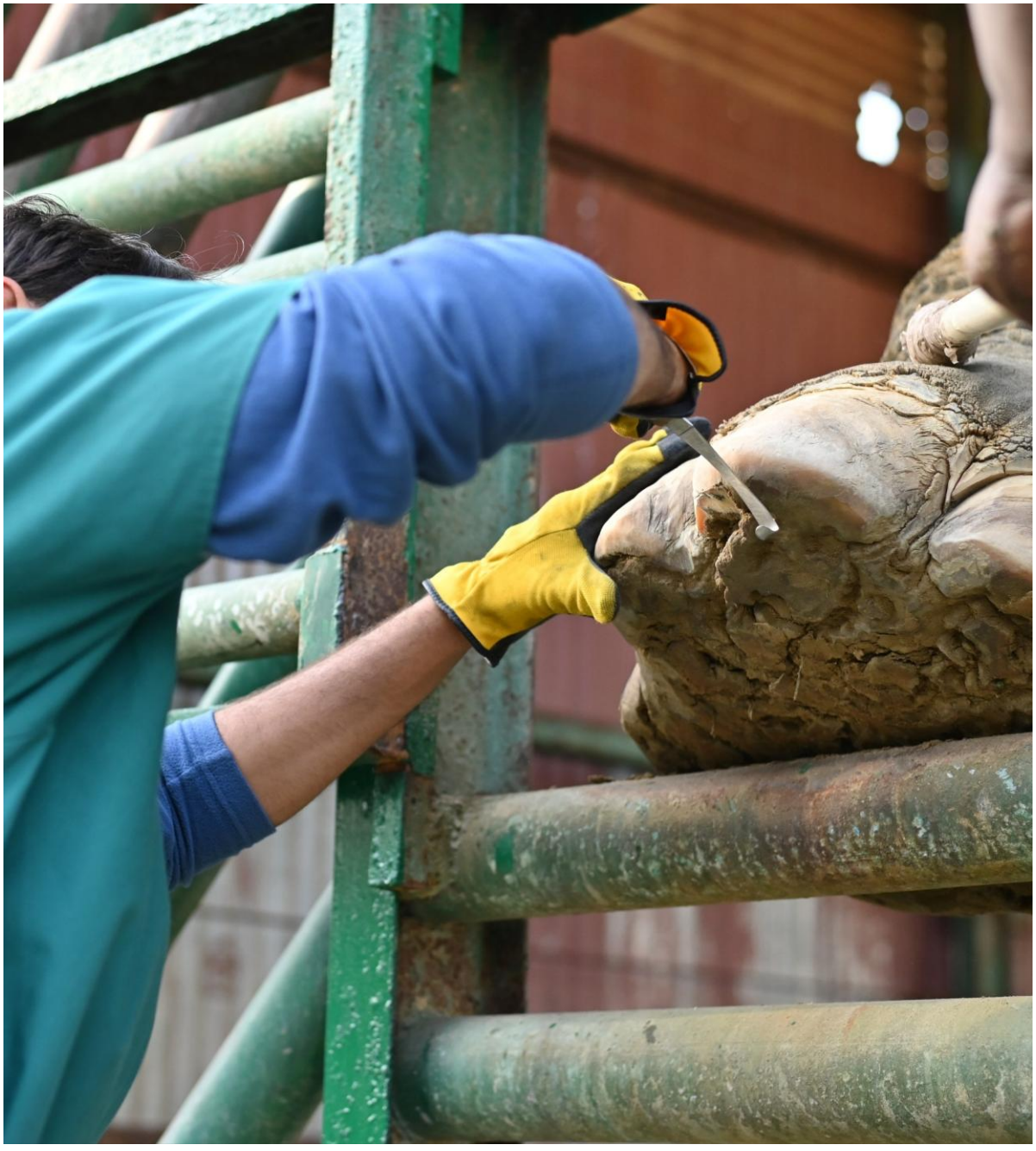
6.5. Mental stimulation and social interaction

Keeping elephants mentally active and engaged is perhaps the best approach to ensure their overall well-being (including that of foot care) in captivity. In the wild, elephants are actively engaged in finding food, attracting and repelling mates and actively interact with their habitats. Thus, mimicing some of those behaviours, including that of sensory stimulation in the captivity would be desirable. This can be achieved

by implementing tactful foraging techniques that involves elephants to apply their minds to seek food; positive conditioning that foster elephant-handler bonds, and implementation of best practices in enclosure design. Similarly, since elephants are highly social animals, maximizing socializing opportunities in the captivity should be prioritized.

6.6. Periodic Veterinary Care

Preventive veterinary care by monitoring important health parameters is essential in captivity. For captive elephants preventive approach is better than reacting to a disorders or ailments. Along with preventive veterinary care it is also critical to prioritize exercise schedules, particularly for old and injured elephants. Gentle execises such as walking, swimming, and other gentle exercises are needed to promote mobility, strength, joint health, and weight management as obesity of often correlated with poor foot health.



CHAPTER VII

FOOTCARE TECHNIQUES AND TOOLS

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Since proper foot care is essential for maintaining the health and well-being of elephants in captivity, periodic interventions like regular trimming, cleaning, and foot inspection can help prevent problems ranging from minor cracks and abrasions to more serious conditions like abscesses and laminitis. Thus, effective foot care techniques and appropriate tools therein for carrying out such interventions are crucial for caregivers and veterinarians. However, in for proper elephant pedicure, the elephant must be adequately trained to present its feet for a length of time.

This chapter provides an overview of foot care techniques and tools specifically designed for Asian elephants. It also highlights the importance of regular trimming and shaping, proper nail care, and the use of specialized equipment. By learning these basic foot care techniques and utilizing the right tools, caregivers can help prevent common foot problems, reduce pain and discomfort, and promote overall health and mobility in elephants.

7.1. Elephant contact system: free contact and protective contact

i. Free contact: Traditional culture of elephant keeping in India is "free contact". Presently, over 90 percent of the captive elephants in India are maintained in "free contact" system. In free contact, obedience training by mahouts is essential to reliably carryout pedicure procedures. On the other hand, Protected Contact system was developed in the western world, where traditional knowledge of elephant husbandry and mahoutry were scanty unlike range countries.

ii. Protected contact: Protected contact (PC) or elephant restrain device (ERD) is a concept where human and elephants are always protected from one another by a barrier. The PC enclosure is usually ~10 feet high barriers of iron featuring extensive openings that provide access for elephant handlers to conduct various training exercises besides useful during medical care.

7.2. Conditioning the elephant for pedicure procedures

Training elephants to tolerate foot care is a valuable practice. For this, the mahouts need to understand foot anatomy and foot care techniques, including toenail trimming. Mahouts should also condition their elephants to allow foot care. Elephants can learn to associate specific actions with positive outcomes, which can help facilitate procedures like regular foot inspections, trimming, and general maintenance (Fowler 1978, Markowitz 1982, Schmidt 1982). Therefore, establishing a strong and trustworthy bond between elephant and the mahout is critical for any veterinary intervention. This takes time, skill, patience and a thorough understanding of the concerned elephant's health, physical condition, temperament and behaviour. Depending on these factors, the target training sessions can last from weeks and months to years. Ideally, foot examinations and minor procedures should be conducted after bathing, when the elephant is most relaxed.

Positive conditioning encouraging elephants to place their feet – pointers

Through adequate conditioning of elephants, it is possible for them to conveniently place their foot for examination. The target is then used to guide the elephant's foot into position for care. Gentle taps on the foot or movements in front of the elephant's face encourage it to lift its foot. Correct responses are rewarded with treats or praise. Training sessions start short and gradually expand to 15 minutes, with frequent breaks to maintain a positive experience. As the elephant learns to lift its foot on cue, trainers refine the behavior, teaching it to hold specific positions for cleaning or examination. Positive reinforcement encourages the elephant to repeat the behavior, strengthening the association between lifting its foot and receiving a reward. This training enables safe and effective foot care, reducing stress for both the elephant and the trainer while promoting the animal's overall health and well-being.

Fig. 7.1. Elephant trained to touch the target with its head, follow it, or move towards it (© IS)

Fig. 7.2. Elephant foot care tools for pedicure (© IS)

Fig.7.3. Foot presentation on metal stools at free contact and Brush being used for cleaning (© IS)

7.3. Habituating elephants to foot care tools

Many elephants might initially be fearful or resistant to tools used during foot care, like scrapers or trimmers. These tools can be introduced gradually for habituation. The elephant can be desensitized to the tools by rewarding calm behavior while exposing them to the the basic tools such as the knives, hones, and hoof rasp. As the elephant becomes more comfortable with basic foot care, handlers can start using specific tools for treating cracks or infections.

7.4. Training elephants for foot soaking and treatment: Using reward based approach it is possible to goad the elephants to soak their foot in the specifically designed soak basin. The soak basins can be used for carrying out a variety of treatments for foot ailments.

7.5. Minimizing and preventing negative pedicure experiences for elephants: If elephants associate foot care interventions with pain or discomfort, they may become resistant or fearful. Therefore, it's essential that any foot care training process is conducted with care and attention to the elephant's well-being, ensuring that the procedures are not physically or psychologically stressful.

Fig.7.4. Positioning of feet at stool and application of topical medication

Fig. 7.5 Basic Tools for footcare (a) Hoof knives (Right and Left curved), (b) Swiss hoof knife, (c) Loop knife, (d) Rasp, (e) Protective gloves, (f) Foot scrub brush

Elephants in captivity require regular foot care, including scheduled trimming of their feet to maintain optimal health. Foot observation marks the first step in caring for elephant's feet. The care professional must inspect the feet of elephant for indications of infection or injuries and monitor the healing of erstwhile ailments. The nails also necessitate periodic attention to prevent overgrowth and crowding, which can lead to complications. Properly executed pedicures, performed on a consistent 90-day schedule, significantly reduce the likelihood of developing foot-related issues (Roocroft &Oosterhuis, 2001). Regular foot cleaning is paramount to remove dirt, debris, and hazardous substances that accumulate in the sole's crevices. Consistent training and foot care help maintain the elephant's health and prevent issues like cracked nails or infections, which are common in captive elephants without proper foot maintenance. Regular, non-invasive training builds trust between elephants and caregivers, improving the overall welfare of the animal.

For reasons elaborated in the manual, elephant feet are prone to a variety of disorders and ailments in captivity. Such ailments undermine the overall quality of life and thus emerge as one of the major challenges facing elephant welfare in captivity. The introductory chapter in this manual strongly contends that preventive care is desirable over later interventions like treatment of foot disorders, which is inherently complicated and practically difficult for elephants.

Preventive footcare can be implemented in many ways, as elaborated in the manual. It includes focusing on better housing, appropriate flooring, providing optimal nutrition, timely pedicure interventions, ensuring balanced exercise, and institutionalising periodic monitoring by veterinary professionals. Among the many stakeholders, the role of elephant handlers is critical, particularly in the early detection of symptoms of foot-related ailments and reporting them on a timely basis to veterinarians. In situations where foot health is already compromised, preparing elephants physically and mentally for undergoing treatments is also the role of the elephant. Thus, continuous mutual engagement between veterinarians, wildlife management officials, elephant handlers, and other ancillary institutions such as religious establishments, private organisations, elephant owners, animal husbandry officials and others concerned assumes a priority.

This book succinctly summarises working knowledge on various aspects underpinning elephant footcare. The next step in the right direction is to disseminate the knowledge to field practitioners. Further, a practical demonstration of field practices would also complement the theoretical aspects covered in the manual. Thus, frontline personnel engaged in captive elephant management are actively encouraged to document footcare concerns, treatment procedures and outcomes therein so that knowledge on elephant footcare is continuously updated

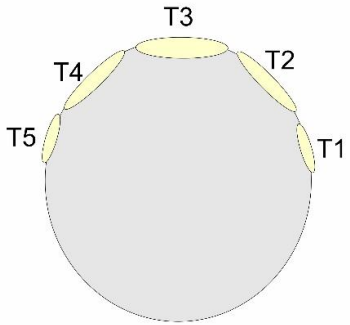
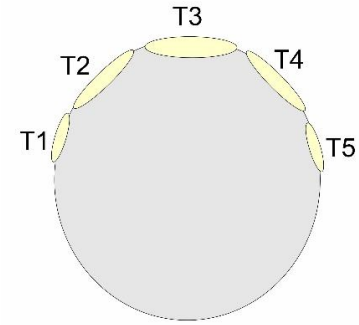
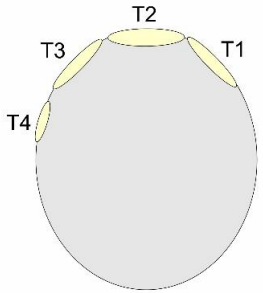
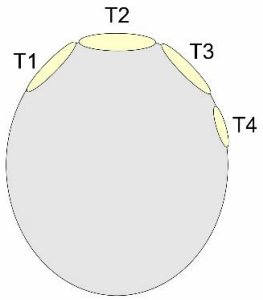
Major improvements in the foot health of elephants seem possible by embracing innovations in enclosure design and flooring materials, and complemented by environmental enrichment. Additionally, the integration of cutting-edge technologies, such as advanced imaging techniques and wearable sensors, will enable practitioners to monitor foot health more effectively, detect potential issues earlier, and provide targeted interventions.

Furthermore, collaborative efforts between researchers, veterinarians, and elephant care professionals will be essential in advancing understanding of elephant foot anatomy, physiology, and pathology, ultimately informing evidence-based best practices for foot care. By prioritising elephant foot health and accepting innovative approaches, captive elephant welfare can be significantly improved.

Annexure 1

Foot Care Record Template

Annexure 1. Foot Care Record Template

Parameters	Right front foot					Left front foot					Right hind foot				Left hind foot			
																		
	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5	T1	T2	T3	T4	T1	T2	T3	T4
Nail Characteristics																		
Overgrown toenail																		
Toenail crack (horizontal)																		
Toenail crack (vertical)																		
Split nail extended up to cuticle																		
Nail abscess																		
Infected toenail with fluid pocket																		
Others (_____)																		
Cuticle Characteristics																		
Overgrown cuticle																		
Cuticular feathering																		
Interdigital cuticular growth																		
Abscess of fluid pockets behind cuticular growth																		
Others (_____)																		
Foot pad / Sole Characteristics																		
Cracked sole																		
Sole abrasion / Bruises / Contusions																		
Pododermatitis																		
Avulsion or ulcerations																		
Solar abscess																		
Erosive/ Proliferative lesions																		
Others (_____)																		

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