

A Review on The Role of Footwear Design in Archery: Insole Design Considerations & Fabrications

Siti Ruzimah Kamaruddin^{1*}, Mohd Shahrizal Dolah¹, Ahmad Rizal Abd Rahman¹,
Mon Redee Sut Txi²

¹ Faculty of Design & Architecture, Universiti Putra Malaysia (UPM), Serdang, Malaysia

² Faculty of Sport Science & Coaching, Universiti Pendidikan Sultan Idris (UPSI), Tanjung Malim, Perak, Malaysia

*Corresponding Author: gs69276@student.upm.edu.my

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Abstract: *This review synthesizes current research on the biomechanics of archery stance, with a focus on footwear design attributes and their influence on performance and injury prevention. By reviewing methodologies such as motion capture, plantar pressure mapping, and material testing, footwear features including arch support, sole rigidity, and traction, among others, impact postural stability, weight distribution, and kinetic efficiency, which are crucial during archery. Key findings highlight that footwear innovations, such as contoured arch supports and energy-return midsoles, improve shooting consistency and mitigate risks of overuse injuries. Customized designs, including cast and 3D-printed insoles with load distribution structures, enhance stance stability by optimizing foot alignment and redistributing plantar pressure. Advanced nanocomposite materials demonstrate potential for durable energy retention. The review underscores footwear as a critical biomechanical interface, bridging theoretical principles and practical design applications. By contextualizing these advancements, this review identifies gaps in personalized design protocols and calls for interdisciplinary collaboration to translate biomechanical insights into performance-enhancing, injury-resilient footwear for archers.*

Keywords: Archery Biomechanics; Stance Stability; Footwear Design; Plantar Pressure Redistribution; Injury Mitigation; Personalized Insoles

1. Introduction

The performance of archers and the associated risk of injury are intricately linked to biomechanical elements, particularly the archer's stance, posture, and movement dynamics. The choice of footwear is crucial in stabilizing these factors, aiding in proper alignment, and alleviating strain during repetitive actions. This review explores the impact of footwear design, including material properties, structural integrity, and sole configuration, on optimizing balance, center of gravity, and kinetic efficiency, thereby presenting a possibility to enhance shooting consistency in archery and promote athletes' longevity. By examining the biomechanical requirements inherent in archery, this research emphasizes the importance of footwear as a functional necessity rather than a mere accessory, highlighting its role in reducing injury risks and sustaining precision. Furthermore, insights into innovative materials and customized designs may pave the way for advancements that enhance comfort, adaptability, and performance in dynamic shooting environments.

2. Methodology

The literature review presented in this paper follows the "Systematic Literature Review Synthesis Process" (Masiran et al., 2020; Luo et al., 2022; Zou et al., 2023; Wu et al., 2024; Wong et al., 2024). This process is a stand-alone literature review typology (Rousseau et al., 2008; Templier & Paré, 2015) known to make sense of a selected body of existing literature, leading to decisions regarding the background theoretical context in the early research ideation phase. Topics were identified using Ibrahim's (2008, 2011 & 2020) research question (RQ) construct categorization technique for identifying three different RQ constructs "WHO," "WHAT", and "HOW" in formulating the main research question. "WHO" is defined as the element being impacted by the study, "WHAT" is the information or body of knowledge required to solve the problem, and "HOW" is the targeted impact of the study. In this study, "WHO" is Footwear Impact in Archery, "WHAT" is Footwear Design Consideration, and "HOW" is Customization for enhanced performance.

This study identified the insole design considerations, fabrications, and footwear impact on archery's biomechanical stance. Literature articles were identified through the Scopus database using keywords related to the (1) ["biomechanic" AND "archery"]; (2) ["archery" AND "stability" AND "posture"]; (3) ["footwear" AND "posture"]; (4) ["custom" AND "insole"]. The limitations are set to (a) articles published in the year 2008 – 2024, (b) empirical research articles, (c) English language articles, and (d) journal publications. A total of 776 articles were obtained and sorted by relevance. After the title and abstract review, 33 were selected for analysis. The outcomes included the main findings of previous scholars, how their works could support this study, and recommendations to strengthen the potential solution. The findings of the analysis were then separated into three subthemes (Footwear Impact in Archery, Footwear Design Consideration, and Customization for Enhanced Performance) based on their importance, even though some subthemes may not have many academic articles to refer to due to their emerging nature.

The results of this exercise generated a comprehensive overview for each subtheme, which the study further cross-analyzed, integrated the possibilities, and prioritized the potential solution. The prioritized results were then discussed and synthesized further to form a proposed theoretical model as a potential solution for design considerations and fabrications on the customized insole. This study adapted Ibrahim & Mustafa Kamal's (2018) systematic literature review synthesis process documentation using the online EAGLE System.

3. Footwear Impact in Archery

3.1 Footwear Impact

Archery biomechanics, including muscle activation, postural control, and draw-force management, are strongly linked to footwear design, influencing stability, alignment, and injury risk. During the shot cycle, coordination of lower-limb kinematics and core stability is essential to maintain balance and distribute forces effectively (Ahmad et al., 2014). Optimal footwear enhances efficiency and prevents injury by incorporating features such as contoured arch support, heel cupping, and cushioned materials that reduce muscle fatigue and absorb impact. Advanced technologies, such as energy-return midsoles inspired by running shoes, further improve efficiency by recycling energy during the shot cycle (Miller et al., 2024). These innovations collectively help archers sustain form, minimize metabolic cost, and reduce joint loading.

Beyond efficiency, footwear plays a vital role in injury prevention. Poorly designed shoes can worsen plantar pressure imbalances or destabilize the kinetic chain, raising risks of injuries such as Achilles tendinitis or lumbar strain (Wang et al., 2024). In contrast, customized footwear designs redistribute plantar pressure and support natural motion, maintaining biomechanical alignment across repeated shots. Integrating biomechanical data like plantar pressure mapping and motion-capture gait analysis ensures footwear is sport- and athlete-specific. This data-driven approach allows precise customization, addressing anatomical variations and movement patterns to maximize performance while minimizing injury risks.

Stance stability is central to archery accuracy and consistency, with foot positioning directly influencing balance and center of gravity. Footwear with appropriate torsional stiffness improves stability during shooting, as supported by studies in badminton footwear where intermediate stiffness balanced flexibility and support (Shen et al., 2024). Similarly, proper postural alignment helps distribute forces evenly, lowering injury risks and boosting performance. Real-time biomechanical feedback can monitor and correct posture, showing its effect on spinal loading and injury risk (Miller et al., 2024). Trained archers anticipate adjustments for stability, particularly during string release (Tisserand et al., 2023), while studies in shooting sports confirm the importance of postural stability for accuracy (Lang & Zhou, 2021).

Movement mechanics also determine precision by stabilizing and controlling motion. Professional archers display superior neuromuscular control, enhancing precision compared to beginners (Azadjou et al., 2023). Technology integration, such as accelerometers and gyroscopes, provides detailed stance and posture feedback, helping maintain consistency. Combining acceleration data with plantar pressure sensors allows accurate estimation of center of gravity, improving performance (Meguro & Hayakawa, 2020). Proper footwear design, such as arch-support insoles, supports correct alignment and improves stance stability. Compound archers using insoles showed decreased plantar pressure imbalances and improved scoring outcomes (Perron, 2022). Shoes preventing excessive pronation or supination further aid alignment, stability, and injury prevention.

Finally, traction, comfort, and material choice strongly influence biomechanics and performance. Proper footwear grip enhances stability, reduces compensatory muscle activity, and improves posture during draw and release (Ahmad et al., 2014; Miller et al., 2024). Comfortable shoes reduce fatigue, helping archers maintain focus, while sole thickness and cushioning enhance balance and shock absorption. Addressing issues like hallux valgus and fatigue improves long-term performance, as footwear comfort directly affects accuracy. Prolonged standing in archery causes discomfort in the lower back and limbs, with footwear material influencing plantar pressure and perceived fatigue. Individual preferences also affect medial midfoot contact area (Anderson et al., 2018). Comparisons with running research show that footwear alters mechanics under fatigue, redistributing joint work and influencing endurance (Sanno et al., 2021). Thus, footwear design plays a critical role in archery by balancing biomechanics, comfort, and injury prevention.

In conclusion, footwear design for archers focuses on stability, comfort, support, and the integration of advanced materials and technologies. Key design features such as ergonomic support, biomechanical considerations, and innovations like personalized insoles and 3D printing enhance performance, balance, and comfort, ultimately optimizing archery outcomes.

Table 1: Footwear Impact in Archery

| Category | Key Insights | Impact on Archery | References |
|---|--|---|--|
| Biomechanics & Efficiency | Footwear influences muscle activation, postural control, and force distribution. Features like contoured arch support, heel cupping, and cushioned midsoles improve efficiency. Energy-return midsoles recycle energy. | Enhances stability, reduces fatigue in back/shoulders, minimizes metabolic cost, and lowers joint loading during stance and shot cycle. | Ahmad et al., 2014; Miller et al., 2024 |
| Injury Prevention | Poor footwear may cause plantar pressure imbalance, Achilles tendinitis, lumbar strain. Tailored designs redistribute pressure and support natural motion. | Reduces risk of overuse injuries, supports musculoskeletal health, ensures sustainable training. | Wang et al., 2024; Sasikumar et al., 2025; Chang et al., 2025 |
| Stance & Stability | Proper torsional stiffness and weight distribution enhance balance. Studies from badminton footwear show benefits of intermediate stiffness. | Improves shooting accuracy, consistency, and faster skill progression. | Shen et al., 2024 |
| Postural Alignment | Proper alignment reduces injury and improves accuracy. Motion tracking shows posture impacts spinal forces. Archers adjust posture dynamically during release. | Supports consistent form, prevents spinal/limb strain, boosts accuracy. | Miller et al., 2024; Tisserand et al., 2023; Lang & Zhou, 2021 |
| Movement Mechanics & Sensors | Neuromuscular control and sensor tech (accelerometers, gyroscopes, plantar pressure sensors) improve stance and posture feedback. | Provides real-time correction, enhances precision, develops consistent technique. | Azadjou et al., 2023; Meguro & Hayakawa, 2020 |
| Insole Support & Pressure Distribution | Arch-support insoles reduce CoP excursion and rebalance plantar pressure. Compound archers using insoles achieved higher scores. | Improves stance stability, performance, and lower-limb alignment. | Perron, 2022 |
| Traction & Grip | Grip affects force distribution, muscle activity, and posture. Stable base reduces compensatory actions. | Improves energy efficiency, reduces fatigue, ensures balance during draw/release. | Ahmad et al., 2014; Miller et al., 2024 |
| Comfort & Endurance | Proper sole design (thickness, materials) reduces fatigue, prevents hallux valgus, and lowers back/limb discomfort. Prolonged standing requires cushioning. | Enhances focus, shooting accuracy, and prolongs training duration. | Anderson et al., 2018; Sanno et al., 2021 |
| Innovation & Customization | Use of 3D printing, personalized insoles, and biomechanical data integration (plantar maps, motion capture). | Athlete-specific design, maximizes performance and minimizes injury risk. | Recent trends |

3.2 Footwear Design Consideration

Archery requires stability and even plantar pressure distribution to enhance performance, particularly in tasks requiring precision and balance. Arch-support insoles have been shown to improve shooting scores in compound archers by reducing the center of plantar pressure (CoP) excursion, thus enhancing stability during arrow release. These insoles help redistribute plantar pressure, reducing it in the left posterior zone while increasing it in the correct anterior zone, leading to a more balanced stance (Perron, 2022). In sports footwear design, a balance between lightweight construction, durability, cushioning, and support is critical. EVA foam is widely used for midsoles due to its cushioning, but it lacks mechanical strength and energy return compared to polyether block amide (PEBA). While PEBA initially provides better running economy, after prolonged use (450 km), its performance aligns with EVA, underlining EVA's durability and efficiency over time.

Recent studies have focused on strengthening EVA's weaknesses while enhancing its benefits. Nanocomposite foams with multi-walled carbon nanotubes (CNT) improve abrasion resistance and compressive strength without compromising energy return, making them suitable for lightweight, high-rebound midsoles (Chang et al., 2023). Similarly, composite outsoles with larger surface areas and tread patterns, such as circular plugs, improve slip resistance and traction (Islam et al., 2023). Advances in breathable materials, such as openwork spacer fabrics, enhance airflow and heat transfer, increasing comfort during prolonged wear (Kaziur et al., 2022). Future research directions highlight the potential of thermoformable materials and resistive-heating foils for insole customization, thereby further improving performance and sustainability.

Custom insoles play a crucial role in reducing plantar pressure and improving alignment. In individuals with pes planus, they effectively decrease valgus angles and medial foot load (Aydođan et al., 2023). Modern approaches like the Finite Element Method (FEM) simulate foot pressure distribution, allowing the optimization of material properties for enhanced comfort and support (Yang et al., 2022). Sensorized insoles, equipped with custom resistive force sensors, provide real-time feedback on ground reaction forces, improving gait analysis and supporting personalized footwear solutions. Embedded pressure sensors further alert users to mismatched weight distribution, which is especially beneficial for archers who spend long periods standing, thereby reducing fatigue and lower limb strain (Ghosh et al., 2017).

Despite these advancements, accessibility and cost remain significant challenges. The complex design and production processes restrict custom insole availability to niche markets. Pressure mapping has been applied to create personalized insoles by analyzing plantar pressure maps, helping optimize foot load distribution to prevent injuries (Spahiu et al., 2021). Furthermore, force platforms are employed to assess CoP excursions, providing valuable insights into archers' postural stability. Affordable force platforms offer practical solutions for archers to monitor and improve balance and performance, making them valuable tools for both athletes and researchers (Fauzi et al., 2021).

Finally, additive manufacturing and 3D modelling have opened new opportunities in footwear customization. Technologies such as 3D printing enable highly precise insole designs tailored to individual foot contours and pressure points, thereby enhancing comfort, performance, and injury prevention (Mallakpour et al., 2024). Fused Deposition Modelling (FDM) allows the production of complex structures, like gyroid infills, which offer energy absorption and customizable density (Sankineni & Kumar, 2023). At the same time, traditional casting remains relevant due to its simplicity and accessibility, particularly in healthcare and emergency settings, where quick fabrication and application are crucial (Wang et al., 2021). Together, these approaches highlight the balance between cutting-edge innovation and practical usability in the development of customized insoles.

In conclusion, personalized insoles, particularly those created using 3D printing, offer significant benefits by addressing individual biomechanical needs, improving comfort, and reducing musculoskeletal issues. The precision of 3D printing enables tailored designs that enhance foot alignment and pressure distribution, though challenges like limited materials and production time persist. Due to these limitations, conventional casting materials are a good alternative with many advantages.

Table 2: Footwear Design Considerations in Archery

| Design Aspect | Key Features / Technologies | Impact on Archery Performance | References |
|---|--|---|--|
| Plantar Pressure & Stability | Arch-support insoles reduce CoP excursion; redistribute plantar pressure (↓ left posterior, ↑ right anterior). | Improves stability and shooting accuracy during arrow release. | Perron, 2022 |
| Midsole Materials | EVA foam – cushioning, durable but limited energy return; PEBA – higher rebound, less durable over time. | Balances comfort, durability, and efficiency for prolonged archery stance. | Chang et al., 2023 |
| Nanocomposite Foams | CNT-enhanced foams improve abrasion resistance, compressive strength, and rebound. | Lightweight, durable midsoles with better performance and sustainability. | Chang et al., 2023 |
| Outsole & Traction | Composite outsoles with larger surface/tread patterns (e.g., circular plugs). | Enhances grip, slip resistance, and stability during stance. | Islam et al., 2023 |
| Breathability & Comfort | Openwork spacer fabrics, thermoformable materials, resistive heating foils. | Improves airflow, heat transfer, and long-term comfort during prolonged shooting. | Kaziur et al., 2022 |
| Custom Insoles & Foot Alignment | Insoles reduce valgus angle, redistribute medial foot load in pes planus cases. FEM simulations optimize design. | Enhances foot alignment, reduces plantar pressure, prevents injuries. | Aydoğan et al., 2023; Yang et al., 2022 |
| Smart / Sensorized Insoles | Embedded pressure & force sensors for real-time gait and weight distribution monitoring. | Provides feedback to correct balance, prevents fatigue and injury. | Ghosh et al., 2017 |
| Pressure Mapping & Force Platforms | Plantar pressure maps & COP excursion measurement. Affordable force platforms assess stability. | Enables archers to monitor and train balance effectively. | Spahiu et al., 2021; Fauzi et al., 2021 |
| 3D Printing & Additive Manufacturing | FDM, gyroid structures, infill density adjustments for customization. | Tailored insole design, precise pressure relief, enhanced comfort and alignment. | Mallakpour et al., 2024; Sankineni & Kumar, 2023 |
| Traditional Casting | Low-tech, fast, widely accessible, useful in resource-limited or emergency contexts. | Quick fabrication, cost-effective alternative to 3D printing. | Wang et al., 2021 |
| Overall Impact | Personalized, biomechanically optimized insoles using advanced materials and manufacturing. | Improve archery stability, comfort, alignment, reduce MSD risk, and optimize performance. | Synthesized from above |

3.3 Customization for Enhanced Performance

Customized insoles are often created using 3D printing, which allows for precise adjustments in density, heel cup, heel rise, and arch height. This customization is crucial for correcting foot biomechanics and providing effective orthotic support, as demonstrated in a study where over 90% of patients reported pain relief after using 3D-printed insoles for foot-related musculoskeletal ailments Shaikh et al., (2023). The use of elastic photosensitive resins in 3D printing allows for flexible and cost-effective production of insoles, offering material control and pressure redistribution benefits Siegkas et al., (2024). Other customized insoles, such as the one with medial wedges, have been shown to significantly reduce pain intensity and improve foot function in individuals with plantar fasciitis. These insoles also positively affect lower extremity kinematics, reducing knee and hallux motion during gait Thong-On & Harutaichun, (2023).

Numerical analysis of plantar pressure points helps design insoles that effectively lower excessive pressure in vital foot areas. This approach is especially useful for conditions like diabetic foot, where redistributing pressure is crucial to preventing ulcers Serrato-Pedrosa et al., (2024). A 3D printed insole with an elastic mesh pad replaces solid arch supports, improving arch compression and recoil during stance. This design has been reported to improve comfort and balance in flatfooted individuals Hu et al., (2022). 3D-printed insoles, customizable to enhance stance stability, redistribute pressure and optimize foot alignment. Gradient lattice structures can cut peak pressure by up to 60.42% versus barefoot Kang & Gong, (2023). Besides 3D prints, materials like gel and foam can be used to create insoles that conform to foot contours, boosting shock absorption and pressure relief. This design meets individual needs and benefits athletes and active people by enhancing performance and reducing injury risk.

Integrating digital techniques improves effectiveness by addressing corrective needs and enhancing comfort and functionality. Additive manufacturing, like 3D printing, creates insoles with customized lattice structures that redistribute plantar pressures, crucial for injury prevention and rehabilitation Siegkas et al., 2024). Digital processes, including 3D foot scanning and CAD modeling, allow for precise customization of insoles to match the foot's geometry and pressure distribution. This method can automatically detect malposition and adjust the insole design accordingly Völz et al., (2023). Others, such as In-silico techniques, use motion capture and musculoskeletal modeling to predict how different insole designs will affect foot kinematics.

This approach enhances the personalization of insoles by providing data-driven insights into their corrective potential Killen et al., (2024). Integrating additive manufacturing and in-silico techniques advances plantar pressure redistribution and injury prevention. 3D printing enables customized insoles that reduce injury risk, while in-silico methods enhance this by modelling the foot's biomechanics. Together, these offer a comprehensive injury prevention approach. However, 3D printing faces challenges like high costs, slow speeds, and limited size, which hinder industry-wide adoption. Additionally, the strength of printed parts can be a concern, particularly in applications requiring high durability Iftekar et al., (2023). The accuracy of 3D printed products can vary, leading to quality issues and extra work to meet finishes. Concerns also exist about environmental impacts, like plastic waste and energy use, which may overshadow the technology's benefits.

Conventional orthotic casts, such as those made from plaster or fiberglass, have a long history of use and are well-documented in terms of their effectiveness in immobilizing fractures and supporting musculoskeletal conditions. They are widely accepted in clinical practice, providing a reliable option for practitioners who are familiar with their application and outcomes. D'Amado et al., (2024). Plaster and fiberglass casts are known for their high compressive strength, which is crucial for maintaining fracture alignment and stability. For instance, plaster casts have demonstrated a compressive yield strength of 309.2 N, which is significant for certain applications. These materials are also readily available and can be quickly applied in emergency settings, making them a practical choice for immediate care Lebowitz et al., (2022). Customized insoles created using cast, 3D printing, and advanced materials, significantly enhance archery performance by optimizing foot biomechanics, redistributing plantar pressure, and improving stance stability. These innovations not only reduce injury risks but also offer tailored solutions for comfort and efficiency, paving the way for future advancements in athlete-specific footwear design.

Table 3: Customization for Enhanced Performance in Insole Design

| Customization Method / Material | Technology / Process | Key Features | Outcomes / Benefits | References |
|---|---|---|--|---|
| 3D Printing (Elastic Photosensitive Resin) | Additive manufacturing | Flexible, cost-effective, material control | Pain relief (>90% patients), pressure redistribution, improved orthotic support | Shaikh et al. (2023); Siegkas et al. (2024) |
| 3D Printing with Medial Wedges | Customized arch support | Adjusts alignment, modifies foot mechanics | Reduced plantar fasciitis pain, improved foot function, reduced knee & hallux motion | Thong-On & Harutaichun (2023) |
| Numerical Plantar Pressure Analysis | Digital modeling & mapping | Identifies high-pressure zones | Prevents ulcers (diabetic foot), redistributes excessive pressure | Serrato-Pedrosa et al. (2024) |
| 3D Printed Mesh Pad (Elastic) | Replaces rigid arch support | Improves compression & recoil | Enhanced comfort and balance in flatfoot | Hu et al. (2022) |
| Gradient Lattice Structures | Advanced 3D print design | Density variation across insole | Cut peak plantar pressure by 60.42% | Kang & Gong (2023) |
| Gel & Foam Insoles | Traditional materials | Conforms to foot contour | Boosts shock absorption, comfort, pressure relief | General application |
| Digital Customization (3D Scan + CAD) | 3D scanning & modeling | Matches geometry & pressure map | Detects malposition, precise correction | Völz et al. (2023) |
| In-silico Techniques | Motion capture + musculoskeletal modeling | Predicts foot kinematics | Personalized corrective potential, improved biomechanics | Killen et al. (2024) |
| 3D Print + In-silico Integration | Combined digital + manufacturing | Data-driven customization | Comprehensive injury prevention & plantar pressure redistribution | Siegkas et al. (2024); Killen et al. (2024) |
| Challenges in 3D Printing | Cost, speed, durability | Limited size, waste concerns | Slower adoption, environmental concerns | Iftekar et al. (2023) |
| Conventional Orthotic Casts (Plaster/Fiberglass) | Manual casting | High compressive strength, widely available | Effective for immobilization, fracture support, quick application | D'Amado et al. (2024); Lebowitz et al. (2022) |

3.4 Discussion

The integration of personalized insoles into archery footwear marks a significant step in enhancing performance, preventing injuries, and supporting rehabilitation. Archery demands precision and stability, and customized insoles specifically designed for an archer's anatomical and functional needs play a key role in optimizing stance and shooting technique. By tailoring support to the individual, these insoles improve both comfort and biomechanical efficiency. Customized insoles address biomechanical challenges that arise from repetitive archery movements. Studies show they can reduce plantar pressure, correct foot alignment, and evenly distribute body weight, all of which help maintain postural stability during aiming and shooting. This results in more consistent performance and reduced center of pressure (CoP) excursions, highlighting their effectiveness in supporting archers during competition and training.

Injury prevention is another crucial benefit of personalized insoles. Repeated draw-and-release actions in archery often lead to overuse injuries, especially in the lower limbs. Custom insoles help reduce risks by controlling pronation and supination, ensuring proper alignment, and lowering musculoskeletal stress. By minimizing injury potential, archers can extend training sessions and sustain long-term performance improvements.

Personalized insoles are also highly valuable in rehabilitation. For archers recovering from foot-related injuries, they provide targeted support, pain relief, and biomechanical correction, reducing the risk of reinjury. However, while 3D printing enables high customization, it faces limitations such as long production times, high costs, durability concerns, and environmental impacts. These factors currently restrict accessibility for widespread sports use.

Despite advancements in 3D printing, traditional orthotic materials like plaster and fiberglass remain widely used due to their reliability, strength, and affordability. Plaster, for example, offers high compressive strength and practicality in clinical and emergency contexts. In conclusion, both approaches have value: 3D-printed insoles offer tailored performance benefits, while traditional materials provide accessible and proven solutions. Future research should aim to balance innovation with cost-effectiveness and sustainability to maximize the benefits of personalized insoles for archers.



Figure 1: Point of Departure (POD) Tree Diagram for Archery Footwear Optimization: from Design Considerations to Customized Insole Solutions (Adapted from Ibrahim & Mustafa Kamal, 2018)

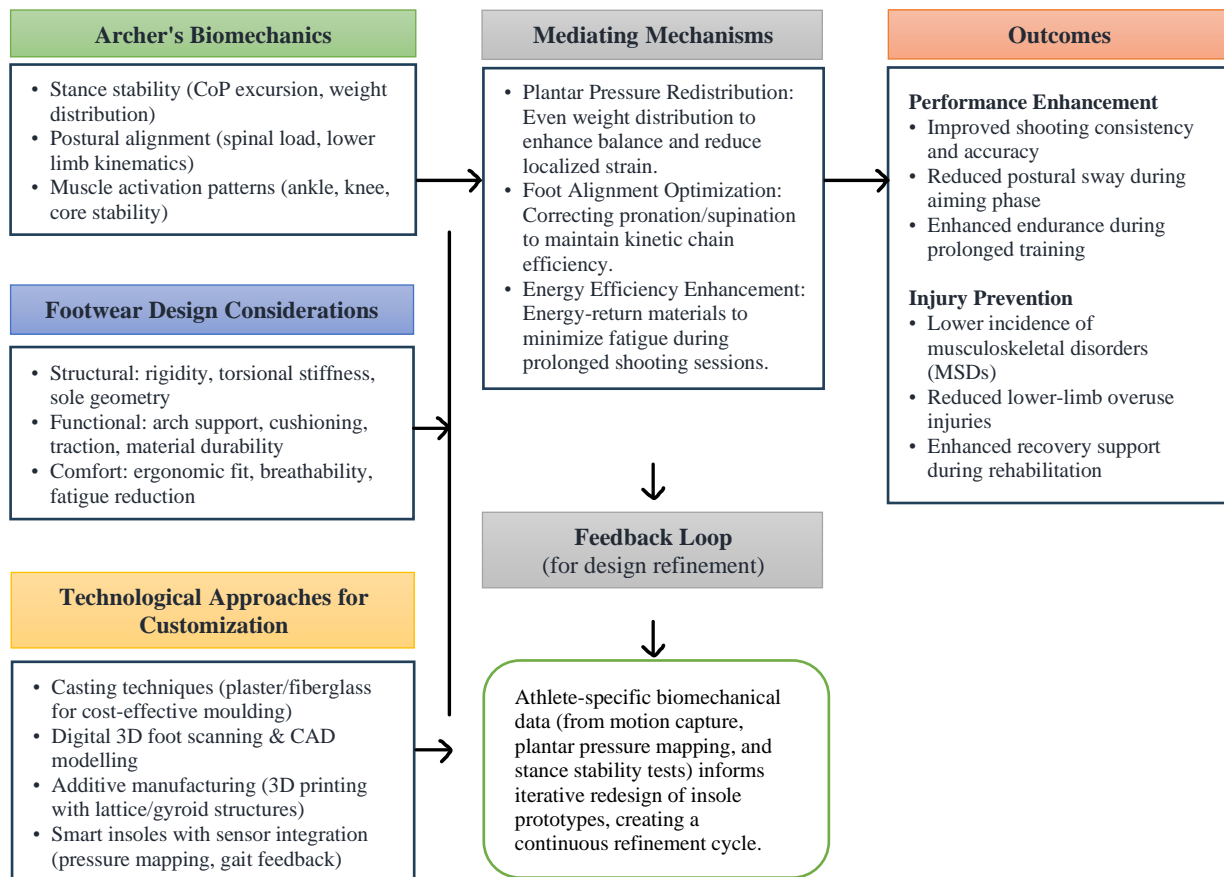


Figure 2: Conceptual Framework for Developing a Customized Insole for Archers

4. Conclusion

The paper reviews current research on the biomechanics of archery stances, highlighting how footwear design features play a crucial role in enhancing performance and preventing injuries. It emphasizes the importance of factors such as arch support, sole rigidity, and traction in improving postural stability, weight distribution, and kinetic efficiency during archery. Key findings from the review show that innovations in footwear, such as contoured arch supports and energy-return midsoles, significantly improve shooting consistency and reduce the risk of overuse injuries. The study underscores the potential of customized designs, including cast and 3D-printed insoles with load distribution features, to enhance stance stability by optimizing foot alignment and redistributing plantar pressure. It also highlights the potential of advanced nanocomposite materials to provide durable energy retention.

The review identifies gaps in personalized design protocols and calls for interdisciplinary collaboration to develop footwear that enhances performance and reduces injury risk for archers. This underscores the need for further research and development to fully leverage biomechanical advancements in footwear design. Overall, the paper concludes that footwear serves as an essential biomechanical interface, linking theoretical principles with practical design. It underscores the importance of ongoing research and innovation to meet archers' unique needs and enhance their performance. The study highlights the role of footwear in archery, key design considerations, and how customized insoles can boost performance.

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Conflict of Interest Statement

The authors declare that there are no conflicts of interest, financial or otherwise, that could have influenced the outcomes or interpretation of this study.

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