

AURYX: Performance and Recovery Footwear Design for Female Pickleball Athletes

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Preface

This paper documents the research and design development of AURYX, a footwear system designed for female pickleball athletes. The name reflects the ideas of air, axis, and aura, representing breathability, movement support, aesthetic expression, and recovery. Through athlete research and design iteration, this project explores how footwear can better support comfort, stability, and recovery for pickleball players.

Introduction

Pickleball has become one of the fastest-growing competitive sports worldwide, attracting increasing numbers of female athletes. However, most footwear options available today remain adaptations of men's models, overlooking women's unique biomechanics such as narrower heels, wider forefeet, and different balance mechanics. In addition, most pickleball shoes currently on the market are derived from tennis or general court shoe designs, rather than being developed specifically for pickleball movement patterns. This often results in discomfort and limited performance on court.

To address these gaps, this project focuses on designing an adaptive footwear system for elite female pickleball players, tailored to both indoor and outdoor environments. By analyzing surface conditions, temperature, and movement demands, the collection proposes specialized solutions for competition, training, and recovery. The goal is to create products that truly reflect women's athletic needs and enhance their performance across different playing conditions.

Sport History



Figure 1

Co-inventor of pickleball, Congressman Joel Pritchard (left), and former Governor Dan Evans prepare for a game. Photo © Pickle-Ball Inc. (n.d.). History of Pickleball

Pickleball was invented in 1965 in Bainbridge Island, Washington by Joel Pritchard, Bill Bell, and Barney McCallum as a backyard game that combined elements of tennis, badminton, and ping pong (USA Pickleball, 2020). Its accessible rules and small court size quickly made it popular among families and community centers, where both men and women could play together.

During the 1970s and 1980s, pickleball became particularly popular among women in retirement and recreational communities, offering an approachable yet competitive form of physical activity. By the early 2000s, the sport transitioned from leisure activity to organized competition, with national tournaments and media exposure accelerating its growth.

Today, pickleball is one of the fastest-growing sports in the United States, with over 13 million active participants, nearly half of whom are women (Sports & Fitness Industry Association, 2024). Female athletes such as Anna Leigh Waters and Catherine Parenteau have elevated its visibility and athletic credibility. However, despite this growth, product development for female pickleball players remains limited, with few options designed specifically for women. This gap highlights the

continuing underrepresentation of female athletes in sports product innovation—a challenge that persists across many categories of performance footwear.

Unmet Design Needs in Women's Pickleball Footwear

Female participation in pickleball has increased dramatically in recent years, with women now accounting for nearly half of all players in the United States (Sports & Fitness Industry Association, 2024). Despite this surge, the footwear market continues to overlook the specific needs of female athletes. A review of major brands, including New Balance, Skechers, ASICS, and FILA, reveals that while over 30 models of pickleball shoes are marketed for men, only four models are labeled for women, and several of those are simply resized men's designs. These models fail to address female-specific biomechanics such as narrower heels, wider forefeet, lower body mass, and different balance centers (Watkins & Dunne, 2015). As a result, many women athletes resort to wearing tennis shoes, which are built for taller and heavier players and do not accommodate the faster, lower-impact, multi-directional movements of pickleball. For example, the current world No. 1 women's tennis player, Aryna Sabalenka, stands at 182 cm, whereas the top women's pickleball player, Anna Leigh Waters, is around 167 cm tall. This physical difference reflects not only variations in mass and stride length but also in impact force and agility demands. In addition, a single tennis court covers area equal to 2.4 pickleball court, meaning pickleball requires quicker directional changes in a more confined space. Consequently, tennis shoes designed for longer sprints and higher vertical impacts often restrict responsiveness and lateral control on pickleball surfaces.

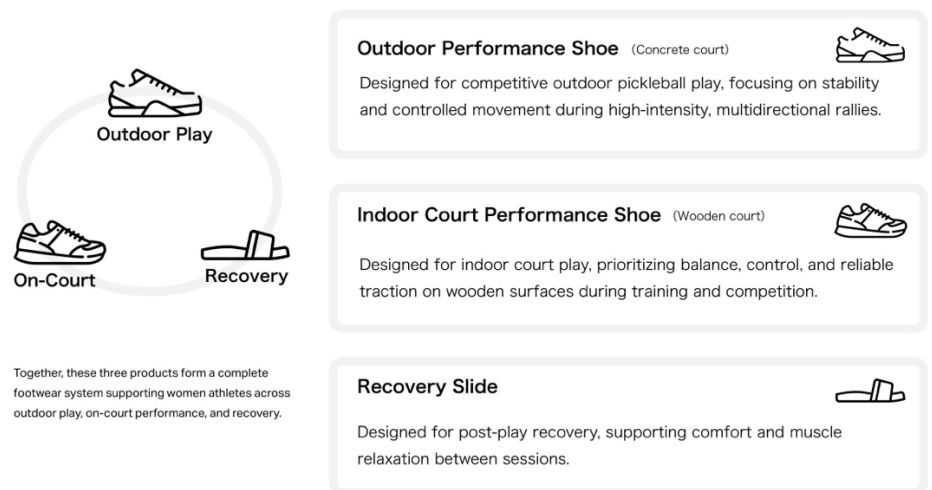
The mismatch between product design and user performance demands often leads to reduced agility, loss of ground feedback, and increased risk of overuse injuries. Professional player Anna Leigh Waters noted in a 2025 podcast that repeated lateral movements during tournament play caused knee discomfort, emphasizing the sport's unique biomechanical stressors on female bodies (Waters, 2025). Current tennis-based designs tend to overemphasize stiffness and vertical cushioning, which limits

responsiveness and control on smaller pickleball courts. These gaps highlight a critical opportunity for innovation in women’s pickleball footwear. Future designs should explore optimized cushioning ratios tailored to lighter, low-impact athletes; flexible forefoot hinge structures for diagonal and lateral motion; and outsole traction mapping derived from motion-capture data.

Problem Statement

As female participation in pickleball continues to grow, most existing footwear adapted from tennis does not fully support the sport’s specific movement patterns. Pickleball involves frequent sudden stops, quick lateral movements, and rapid pivots, often repeated across multiple matches in a single day. Many current shoes also lack sufficient breathability and recovery support. This leads to trade-offs between stability, cushioning, court feel, and overall comfort for women players.

Product Classification



Gigi Chen

UO SPD 688

Figure 2

Visual line plan showing the three-product system across play, training, and recovery

This thesis proposes a three-product footwear system designed for female pickleball players, addressing different levels of play across the full performance

cycle from competition to recovery. Each product supports a specific phase of the athlete's experience — competition, practice, and recovery, forming a coherent and adaptable collection.

1. Outdoor Performance Shoe

Outdoor matches on hard acrylic-coated concrete courts require athletes to perform frequent sudden stops and explosive directional shifts. Research will focus on how these rapid decelerations influence foot containment, toe impact, and stability, especially for female athletes.

2. Indoor Performance & Practice Shoe

During routine indoor play and practice, many female pickleball players play on wooden sports floors, which are commonly found in community gyms and recreational facilities. Compared to outdoor hardcourt surfaces used in competition, such as acrylic-coated concrete, indoor floors show clear differences in traction behavior and surface rebound. This research focuses on how these surface differences affect traction, foot stability, cushioning, and containment during pickleball-specific movements. The goal is to explore the needs of indoor female recreational pickleball players.

3. Recovery Slide

Post-match recovery plays a crucial role in sustaining long-term athletic performance. This research will analyze the recovery needs of female pickleball athletes after repeated high-intensity decelerations and impact loads. Particular attention will be paid on how these athletes manage muscle relaxation and blood circulation after competition or training. The findings from this phase will provide foundational insights for recovery slide development, focusing on both physiological and psychological dimensions of post-performance regeneration.

Together, these three products create an integrated system that empowers women athletes to perform, recover, and move efficiently across different environments.

User and Market Analysis

The user base for this project includes both elite female pickleball athletes aged 16 to 35 and recreational female players aged 18 to 55, reflecting different levels of participation within the sport.

The primary users are elite female pickleball athletes who compete at high competitive or professional levels, primarily within organized circuits such as the Professional Pickleball Association (PPA), the Association of Pickleball Professionals (APP), and Major League Pickleball (MLP). These athletes train and compete at high intensity and serve as the performance benchmark for the overall footwear system, particularly informing the development of the outdoor performance shoe. Professional athlete Catherine Parenteau has publicly shared her weekly training schedule, which illustrates the demanding routines typical of elite female players. During non-tournament weeks, she practices pickleball drills five to six times per week—primarily through one-on-one sessions—and trains in the gym five times per week, focusing on weightlifting, agility, and sprint work. During tournament weeks, her schedule includes doubles practice and gym sessions on Monday and Tuesday, singles practice and active recovery on Wednesday, followed by four consecutive days of competition (Parenteau, 2023). This example reflects the highly structured and physically intensive lifestyle of elite female athletes and informed the performance benchmarks used throughout this project.

The secondary users are recreational female pickleball players who participate in regular indoor play and practice, particularly in community gyms and recreational facilities where wooden floors are commonly used. While these players may not compete professionally, they represent a rapidly growing segment of the sport and often engage in frequent, repetitive play. This places distinct demands on footwear, especially in terms of comfort, traction control, and impact absorption on indoor surfaces. This user group primarily informs the development of the indoor performance and practice shoe within the three-product system.

The recovery footwear within the system is designed to support both elite and recreational players, addressing shared needs related to post-play comfort, physical restoration, and fatigue reduction between matches or practice sessions. This reflects common recovery behaviors observed across user groups, such as foot rolling, massage, and footwear changes after play.

From a market perspective, the primary regions of focus are North America and Asia, where female participation in pickleball has increased significantly in recent years. According to DUPR, there are now over one million registered pickleball players worldwide (PickleballMAX, n.d.). Based on DUPR's gender and rating distribution, approximately 35,000 elite-level female athletes (rated 4.5 and above) are located in North America, where DUPR adoption is most concentrated. These athletes represent the competitive and professional core of the sport and frequently participate in circuits such as the PPA, APP, and MLP.

Asia represents an emerging yet rapidly expanding market for pickleball. According to PPA Tour Asia (2024), the region now has approximately one million total participants, with growth led by countries such as Japan, China, and South Korea. Applying participation ratios similar to those observed in North America, it is estimated that Asia currently has between 10,000 and 15,000 high-level female players. In total, the combined elite female athlete population across North America and Asia is estimated at approximately 50,000 players.

Beyond the elite segment, the broader recreational market is expanding at an even faster rate. The Sports & Fitness Industry Association (SFIA, 2024) reports approximately 19.8 million total pickleball participants in the United States, of whom 40.9 percent are women, equating to nearly 8 million female players nationwide. This large and diverse group represents the majority of indoor pickleball participation and highlights the importance of addressing footwear needs beyond professional competition.

Despite this substantial and growing user base, the market for women's pickleball footwear remains underdeveloped. Most existing

products are either gender-neutral or scaled-down versions of men's designs, failing to address the anatomical, biomechanical, and comfort needs of female players across different levels of play. This gap highlights a clear opportunity for women-specific pickleball footwear that supports both elite performance and recreational indoor use.

Rules

The rules of women's pickleball are the same as men's pickleball. Matches are typically played to 11 points, and a team must win by 2. Games can be singles or doubles, though women's competitions often emphasize doubles play. The court measures 20 feet wide and 44 feet long, with the net standing 34 inches high at the center. Serves are made underhand and must land diagonally across the court. Only the serving team can score a point, and the ball must bounce once on each side before volleys are allowed (USA Pickleball, 2024). Currently, there are no rule distinctions or dedicated equipment standards for outdoor women's pickleball.

Success

The highest level of success in women's pickleball is winning tournaments and becoming a top player. Players often measure their progress through shot accuracy, quick reactions, and teamwork. Pickleball values stability and smart shot choices more than pure power. Keys to success include good footwork, balance, and control. Because the game requires quick direction changes and precise paddle movements, footwear and gear that provide flexibility, stability, and comfort are also important for performance.

Jobs to Be Done

During pickleball play, several key movements place repeated stress on the lower limbs, especially the Achilles tendon and calf muscles. Actions such as sudden stops, cross steps, and approach steps create high tension as players quickly accelerate and decelerate within a small court (Harper et al., 2022).

In a sudden stop, athletes must control forward momentum after sprinting, causing the calf muscles to contract eccentrically and the Achilles tendon to absorb large braking forces, which is a pattern consistent with the high neuromuscular and mechanical demands observed in horizontal deceleration across multi-directional sports (Harper et al., 2022). A cross step combines diagonal movement and body rotation, increasing torsional stress on the midfoot and multidirectional pulling on the tendon. The approach step, used to reach short or low shots, involves strong push-off from the forefoot, which repeatedly loads the lower Achilles insertion during plantar flexion.

For female athletes, these motions can be even more demanding due to biomechanical differences such as narrower heels, higher arch, and lower ankle stiffness compared to men (Front Office Sports, 2024). Repeated start and stop movements on hard surfaces like concrete can lead to heel discomfort or tendon overuse if footwear does not provide adequate cushioning and support.

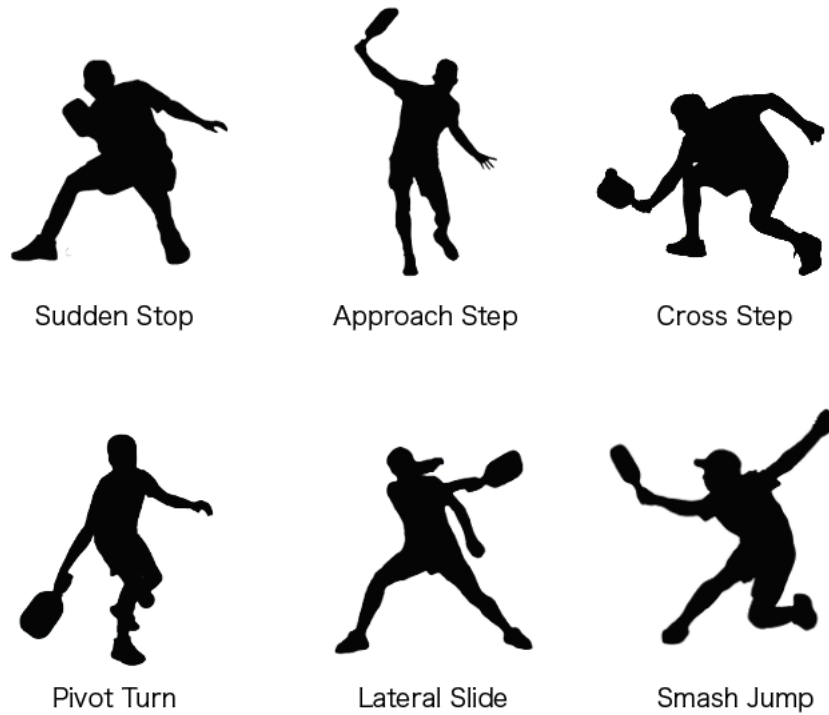


Figure 3

Silhouettes illustrating common movement patterns in pickleball. Created by the author

The lateral movement demands of pickleball require athletes to perform repeated side-to-side motions and rapid braking on hard-court surfaces. As shown in Figure 3, players often generate significant lateral load on the outer forefoot when decelerating or pushing off. This action creates high stress along the shoe's lateral edge and forefoot area, highlighting the importance of reinforced outsole geometry and targeted cushioning in footwear design.



Figure 4

Lateral braking during pickleball play generates high load on the outer forefoot. The image shows an athlete performing a side-step movement on a hard-court surface, illustrating lateral load direction. Source: NovoTrack (<https://www.novotrack.ltd/pid18469972/Best-Portable-Pickleball-Court-Flooring-NovoTrack.htm>). Annotated by the author

Therefore, women's pickleball players require footwear that can reduce Achilles tendon loading through proper heel cushioning, ankle support, and overall stability during quick start-stop movements. These biomechanical insights help guide future design decisions focused on performance and injury prevention (Better Pickleball, 2023; Harper et al., 2022; American Heart Association, 2024).

Environment

The design focuses on footwear for outdoor and indoor pickleball courts, which vary slightly in surface texture and environmental conditions.

Most outdoor pickleball courts are made of textured acrylic-coated asphalt or concrete, similar to tennis courts, providing moderate friction and firm ground contact. These surfaces can become slippery under high humidity or dust, requiring reliable traction from footwear (The Club at Castlewood, 2024).

Indoor courts, on the other hand, are often built with urethane or maple wooden gym flooring, offering smoother and more consistent grip but less shock absorption (The Club at Castlewood, 2024). Although wooden floors provide stable rebound and uniform traction, their structure absorbs less impact energy compared to acrylic or rubber-based outdoor courts. As a result, footwear used on indoor surfaces must compensate through midsole cushioning and flexible traction zones to reduce stress on the joints.

The sport is commonly played in temperate to warm climates, with outdoor temperatures ranging from 15°C to 35°C and humidity levels between 40% and 80%, depending on region and season. These conditions place high demands on

breathability and moisture management, especially during long matches or tournaments (The Club at Castlewood, 2024).

Product Rules

Outdoor pickleball does not have an explicit rule requiring non-marking soles, most facilities and tournaments restrict shoes that could scratch or damage the acrylic court surface. Players are expected to wear court-specific footwear with smooth, non-abrasive outsoles and light-colored rubber to avoid leaving marks or residue (Selkirk Sport, 2024).

In contrast, indoor pickleball courts—typically made of wood or polyurethane flooring—require shoes with non-marking rubber outsoles to prevent floor damage or scuff marks (Selkirk Sport, 2024). Hard or dark-colored soles that leave streaks are not permitted. Players must wear court-specific shoes that provide stable traction and controlled grip, and ensure the soles are kept clean to maintain safety and surface quality.

Competitors Analysis

Outdoor Women's Pickleball Shoes

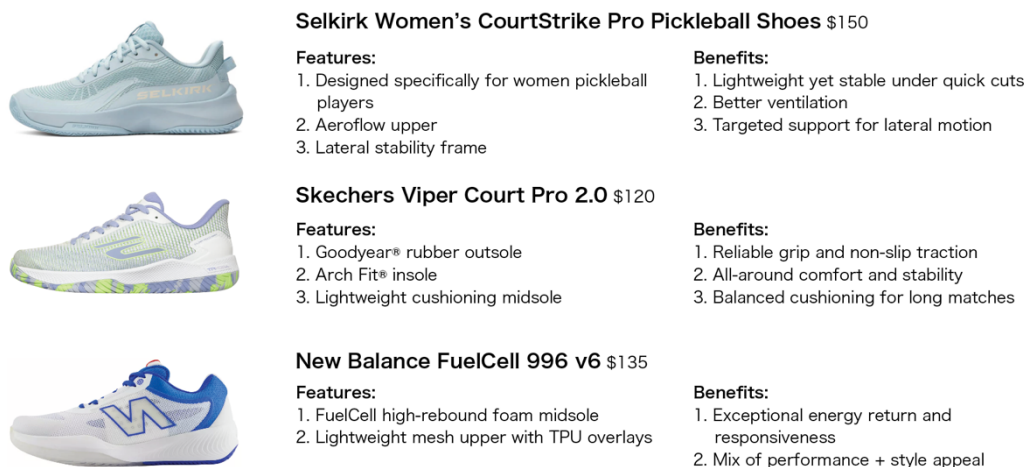


Figure 5

From left to right: Selkirk Women's CourtStrike Pro Pickleball Shoes, Skechers Viper Court Pro 2.0, New Balance FuelCell 996 v6

Currently, there are over 30 pickleball shoe models designed for men, but only about four women-specific options on the market. Many of these are still “shrink it and pink it” versions — simply smaller men's shoes with feminine colorways, rather than designs truly tailored to women's biomechanics.

Figure 2 shows three representative women's pickleball shoes: Selkirk Women's CourtStrike Pro, Skechers Viper Court Pro 2.0, and New Balance FuelCell 996 v6 (Selkirk Sport, n.d.a; Skechers USA, Inc., n.d.; New Balance Athletics, Inc., n.d.).

The Selkirk Women's CourtStrike Pro is one of the few pickleball shoes created exclusively for women. It uses an Aeroflow breathable upper and a lateral stability frame to support quick multidirectional movements. This shoe offering excellent ventilation — a key advantage since pickleball is mostly played outdoors in warm weather. However, the shoe lacks advanced midsole technologies such as energy-return foams or adaptive cushioning systems, making its overall performance feel relatively conventional compared to other brands (Selkirk Sport, n.d.a).

The Skechers Viper Court Pro 2.0 has a Goodyear® rubber outsole, an Arch Fit® insole, and a lightweight cushioning midsole that together deliver reliable traction and all-around comfort. Its gender-specific arch support provides good stability for women players. However, the shoe's visual design language appears overly simple

and less performance-oriented. The bulky silhouette also lacks the refined proportion that modern consumers often expect from professional court footwear(Skechers USA, Inc., n.d.).

The New Balance FuelCell 996 v6 combines a high-rebound FuelCell midsole with a lightweight mesh upper reinforced by TPU overlays, achieving a balance between responsiveness and modern style(New Balance Athletics, Inc., n.d.). However, several users have reported comfort issues. A reviewer from Tennis Warehouse mentioned that while the shoe’s padded upper and soft blue color were visually appealing, it “rides too low with no heel lift,” causing Achilles discomfort and offering little arch support. Another reviewer also noted that even the wider D version felt tight and uncomfortable in the toe box, stating that the shoe was “hitting my feet just sitting on the couch.” This feedback suggests that despite its attractive design and energy-return technology, the 996 v6 may lack the ergonomic comfort and fit consistency necessary for all players, particularly those with wider feet (Tennis Warehouse, 2025).

Indoor Women’s Pickleball Shoes



HEAD Motion Pro Women's Pickleball Shoe \$140

Features:

- 1. Full 360° engineered mesh upper
- 2. Hybrid outsole pattern
- 3. TPU heel counter

Benefits:

- 1. Better ventilation
- 2. Excellent grip without floor marking
- 3. Multi-directional stability



Asics GEL-Rocket 11 Women's Indoor Court Shoe \$75

Features:

- 1. TriBase outsole
- 2. Firm heel with flexible forefoot

Benefits:

- 1. Stable ground contact
- 2. Great for cross-training and court transitions

Figure 6

From left to right: HEAD Motion Pro Women's Pickleball Shoe, Asics GEL-Rocket 11 Women's Indoor Court Shoe

Unlike the outdoor category, there are currently no shoes designed specifically for indoor pickleball training. Most players rely on cross-training or court shoes that offer non-marking soles for wooden indoor courts. Among them, the HEAD Motion Pro and ASICS GEL-Rocket 11 are widely used by female players for practice and recreational play.

The HEAD Motion Pro Women's Pickleball Shoe features a full 360° engineered mesh upper, a hybrid outsole pattern, and a TPU heel counter. This design provides lightweight breathability and multidirectional grip suitable for fast-paced indoor play. (HEAD Sport GmbH., n.d.). The shoe also delivers excellent shock absorption, which is crucial for wooden indoor surfaces where impact energy is less absorbed compared to outdoor acrylic courts. However, several users have reported that the forefoot area feels narrow and stiff, making the shoe uncomfortable for players with wider feet. Others mentioned that the cushioning is mainly concentrated in the heel, offering limited softness at the front of the shoe (Reddit, 2025)

The ASICS GEL-Rocket 11 Women's Indoor Court Shoe integrates a TriBase outsole and a firm heel with a flexible forefoot, providing solid ground contact and lateral stability(Asics Corporation., n.d.). Its greatest advantage is the sidewall support, which gives excellent control during quick side steps — a frequent motion in pickleball rallies. However, some user feedback indicates that the shoe's cushioning feels minimal compared to higher-end models, and the breathability is limited, making it less suitable for longer training sessions in warmer conditions (ASICS, 2025).

Pickleball Recovery Slides

	Selkirk Sport Renew Pickleball Recovery Shoe \$60	Benefits: 1. Lightweight and Comfortable 2. Stimulates blood flow and reduces post-match fatigue 3. Easy to wear after play
	Oofos OOahh Slide \$59.9	Benefits: 1. Reduces stress on feet, knees, and lower back 2. Proven recovery performance after high-impact sports
	Nike Mind 001 \$95	Benefits: 1. Promotes active recovery and comfort 2. Increase blood circulation

Figure 7

From left to right: Selkirk Sport Renew Pickleball Recovery Shoe, OOFOS OOahh Slide, Nike Mind 001 Recovery Slide

Within the recovery footwear market, only the Selkirk Renew is specifically designed for pickleball players. Most other models adopted by athletes, such as OOFOS and Nike recovery slides, originate from running or general sports categories rather than pickleball itself. As a result, the women's pickleball recovery shoes remains largely underdeveloped, presenting opportunities for innovation in comfort, biomechanics, and sport-specific recovery design.

The Selkirk Sport Renew Pickleball Recovery Shoe (\$60) uses an injection-molded EVA foam footbed and a supportive slip-on construction to provide lightweight comfort and easy wearability after play (Selkirk Sport, n.d.b). Its hollow structure enhances ventilation and drainage, making it convenient for outdoor recovery. However, the shoe lacks innovative cushioning or targeted recovery technology, relying on standard EVA material without specialized rebound or energy-return properties.

The OOFOS OOahh Slide (\$59.9) incorporates OOfoam™ cushioning and a biomechanically footbed, effectively reducing stress on the feet, knees, and lower back. It has become a benchmark in the recovery footwear category (Designer Shoe Warehouse, n.d.). However, users have noted that the soft foam tends to compress over time, which decreases responsiveness after extended wear(OOFOS, 2025).

The Nike Mind 001 Recovery Slide (\$95) features a wave-patterned React foam midsole and massage-node footbed designed to stimulate blood circulation and promote active recovery (Nike, Inc., n.d.). Its sculptural silhouette shows Nike’s performance-oriented design language. However, this textured surface can be challenging to clean (Nike, 2025).

Product Anatomy

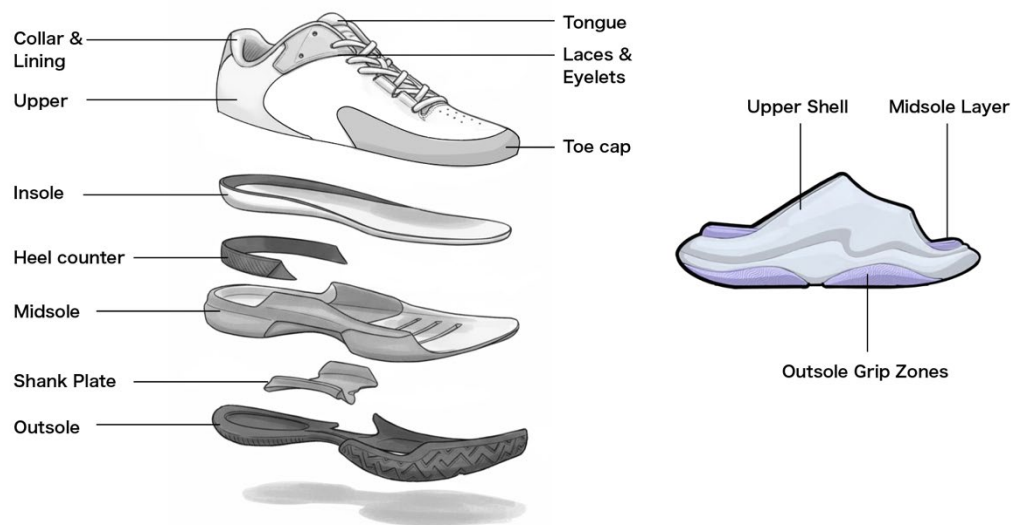


Figure 8

Product anatomy of the women's pickleball performance and recovery footwear. Created by author

Pickleball involves rapid, multi-directional footwork and frequent acceleration and deceleration, which place repetitive forces on the lower limbs and joints. Therefore, footwear designed for pickleball must emphasize lateral stability, lightweight support, and impact cushioning to support players during quick directional transitions on both outdoor and indoor courts. The anatomical structure of pickleball shoes can be divided into three main systems: the upper, the midsole, and the outsole, each contributing to performance, comfort, and recovery.

The upper system secures the foot while maintaining breathability and flexibility for long-duration matches. It is typically constructed with engineered mesh reinforced by TPU overlays and a toe cap to provide lightweight containment and abrasion protection during aggressive play. Laces and eyelets allow personalized lockdown, while a padded tongue protects the instep from lace pressure and enhances comfort.

Around the ankle, the collar and lining improve fit and reduce heel slippage. A reinforced heel counter stabilizes the ankle, minimizing the risk of rolling injuries during lateral braking and quick recovery movements. Women-specific designs often feature a narrower heel geometry and softer collar padding for improved anatomical fit. The insole provides step-in comfort and moisture absorption, offering an immediate cushioning layer against vibration and shock.

The midsole functions as the primary cushioning and energy-return layer. For outdoor performance shoes, supercritical EVA or bio-based foams are used to provide lightweight responsiveness and stability. A TPU shank plate is often inserted to maintain torsional rigidity and balance during side-to-side transitions.

In the indoor training version, the midsole is slightly softer to improve shock absorption on wooden courts, where players experience higher forefoot and toe pressures due to the faster rebound and lower deformation of the flooring. Research comparing wooden and asphalt courts found that wooden surfaces produced higher peak plantar pressures in the forefoot and toe regions, suggesting that wooden indoor courts transmit impact forces more directly to the foot (Kong & Tay, 2018).

The outsole connects the shoe to the court surface and provides traction control. Outdoor versions use durable rubber with deeper traction patterns to resist abrasion from rough court surfaces, while indoor versions adopt non-marking rubber outsoles with shallower tread to prevent damage to indoor court surface.

The recovery slide consists of three main components — the upper shell, inner cushioning layer, and outsole grip layer — designed to support post-match comfort and recovery.

The upper shell provides a slip-on experience, made from lightweight molded EVA that softly wraps the foot and reduces pressure points. The inner cushioning layer integrates gentle acupressure nodes inspired by traditional Chinese medicine. These raised textures stimulate key sole areas to promote blood circulation and muscle relaxation after play. The outsole grip layer ensures traction and safety with a zoned tread pattern that prevents slipping on smooth surfaces. It also helps distribute pressure evenly during walking.

Materials

Modern pickleball footwear uses advanced lightweight materials that balance breathability, stability, and impact protection. Each product type—outdoor performance, indoor training, and recovery slide—requires a different combination of materials tailored to its playing surface and performance needs.

For the outdoor performance shoe, the upper system combines functionality and durability to support high-intensity movement on asphalt courts. It is constructed from polyester engineered mesh reinforced with TPU overlay films, balancing ventilation with lightweight lateral containment. A TPU toe cap is added to enhance abrasion resistance during forward lunges and quick stops. The laces and reinforced eyelets allow for adjustable lockdown across the midfoot, while a soft padded tongue made of mesh and open-cell foam protects the instep from lace pressure and improves comfort. Around the ankle, a knitted or padded collar lining with foam inserts provides cushioning and reduces heel slippage. Internally, a PU foam insole offers soft step-in comfort and vibration absorption. The TPU heel counter stabilizes the rearfoot and prevents ankle roll, while the TPU shank plate provides torsional rigidity through the midfoot to support balanced transitions. The supercritical EVA midsole delivers resilient cushioning and efficient energy return at a reduced weight. Finally, the durable rubber outsole ensures traction and wear resistance on outdoor surfaces, featuring deeper tread geometry for controlled slides and quick recovery.

Outdoor Performance Shoe

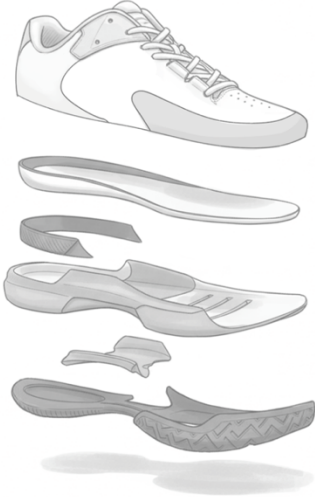
	Tongue	Soft padded textile or open-cell foam + mesh
	Laces & Eyelets	Flat polyester laces with reinforced TPU or metal eyelets
	Collar & Lining	Knitted or padded textile lining with foam inserts
	Upper	Polyester engineered mesh + TPU overlay films
	Toe cap	TPU
	Insole	PU
	Heel counter	TPU
	Midsole	Supercritical EVA
	Shank Plate	TPU
	Outsole	Rubber

Figure 9
Exploded view of the outdoor performance shoe showing major components and material specifications

The indoor performance shoe follows a similar engineered structure but emphasizes cushioning, flexibility, and grip tailored to wooden court conditions. The upper also uses polyester mesh with TPU overlays, maintaining breathability and structural containment. A soft textile tongue, flat polyester laces, and reinforced eyelets ensure adjustable comfort and secure lockdown. The toe cap provides protection from scuffing against smooth court surfaces. Inside, an open-cell PU insole (e.g., Ortholite®) offers greater breathability and moisture control during extended play. The supercritical EVA midsole is tuned to a softer density to absorb high-frequency impacts typical of wooden courts. TPU components in the heel counter and shank plate maintain lateral stability, while the non-marking gum rubber outsole provides high traction without damaging the court surface. Its shallower tread pattern allows smooth grip-and-release transitions during lateral movements.

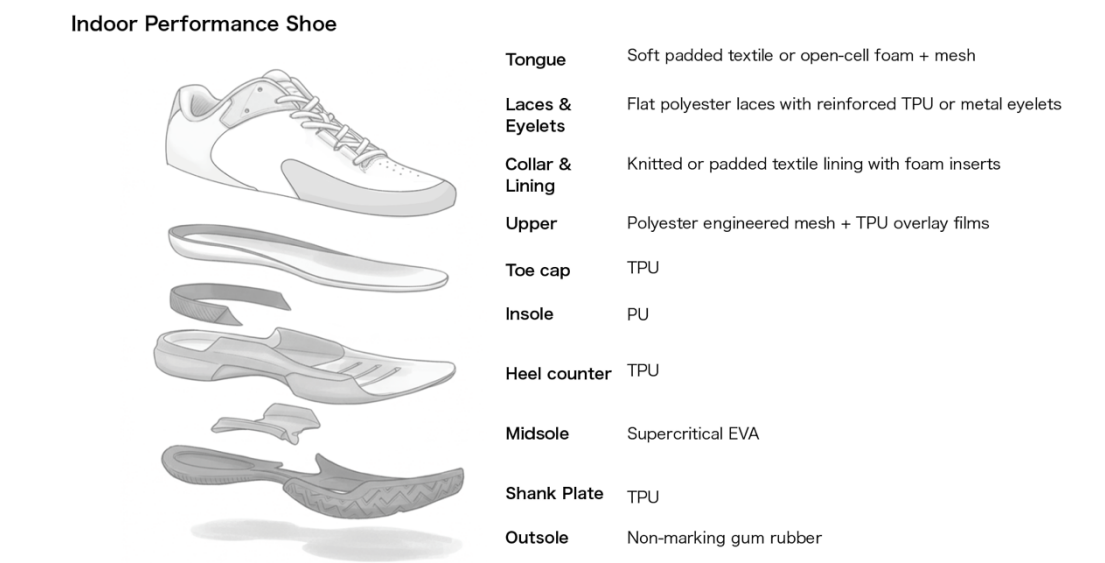


Figure 10
Exploded view of the indoor performance shoe showing major components and material specifications

The recovery slide is made from 100% molded EVA, which provides soft cushioning and flexibility while remaining lightweight and easy to clean. The one-piece construction reduces waste and allows full recyclability.

Pickleball Recovery Shoe



Figure 11

Concept rendering of the pickleball recovery shoe constructed with 100% EVA

Manufacturing Processes

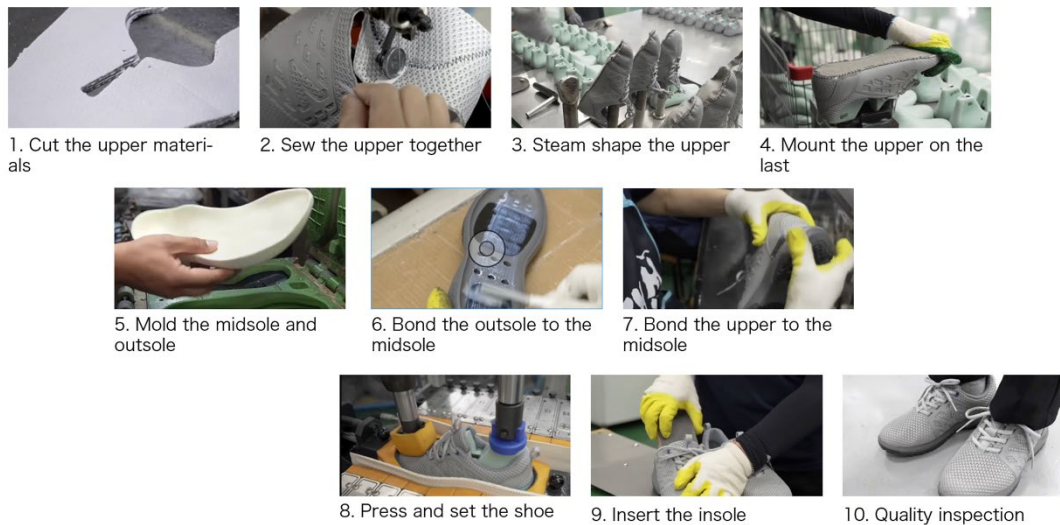


Figure 12

Manufacturing process of the pickleball performance shoe. Images compiled and annotated by the author

For the outdoor and indoor performance shoes, the manufacturing process begins with using automatic cutting machines to cut the upper materials. TPU overlay films or reinforcement layers are then heat-bonded or cemented to the fabric surface for added durability and structure. Afterward, the prepared upper pieces are stitched together with lining layers, forming a complete upper structure. Once assembled, the upper is steam-shaped and mounted on the last to take its final three-dimensional form.

The midsole is made through compression molding of supercritical EVA foam. The outsole is produced using a rubber injection molding process to form the tread

pattern. Any excess midsole or outsole material is manually trimmed. Once both parts are prepared, they are bonded together, and the finished upper is attached to the sole unit using heat-activated adhesive. The shoe is then pressed and set to ensure alignment and bonding strength. Finally, the insole is inserted, followed by quality inspection to ensure consistent performance and fit across all pairs. (The Factory Made, 2024)

Recovery Slide



Figure 13

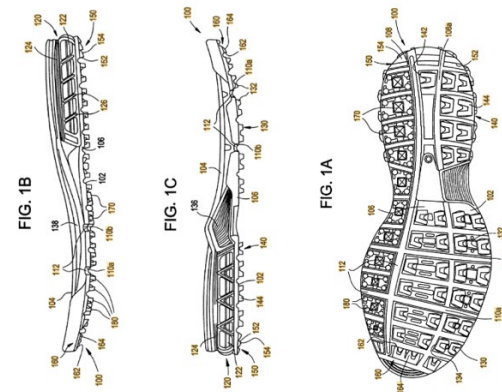
Manufacturing process of the pickleball performance shoe. Images compiled and annotated by the author.

In contrast, the recovery slide follows a simpler single-piece injection molding process. First, EVA pellets are heated to a molten state and injected into an aluminum mold, forming the entire structure of the slide. After cooling, the slides will be manually trimmed and finished, followed by a final inspection to check for air bubbles, surface defects, or dimensional variations (Flightkickz, 2023).

Intellectual Property

The pickleball footwear category is still in its early development stage, with most existing patents reflecting adaptations of court-sport and training shoe technologies. Current findings show that most pickleball-related patents focus on aesthetic differentiation rather than biomechanical performance. Functional innovations remain largely inherited from adjacent categories, particularly tennis and training footwear. For example, Nike's US 11,812,823 B2 patent introduces a flexible foot-support structure that improves balance and responsiveness during multidirectional

movement. Similarly, Selkirk Sport’s D1076389 design patent demonstrates growing interest in visual and brand differentiation within pickleball-specific footwear, combining recognizable panel structures with functional form.



Patent: US 11,812,823 B2

Figure 14

Patent examples Nike Inc., US 11,812,823 B2. Figures compiled from the United States Patent and Trademark Office; layout by the author



Patent: D1076389 – Shoe

Figure 15

Patent examples Selkirk Sport LLC, D1076389. Figures compiled from the United States Patent and Trademark Office; layout by the author

Recovery footwear patents, such as Nike’s US 7,650,707 B2 and OOFOS’s US 2019/0125030 A1, explore outsole feedback systems and two-piece foam constructions, addressing post-match comfort and muscle recovery. Together, these filings illustrate an evolving market where brands seek to merge biomechanical function, structural comfort, and brand expression through innovative materials and manufacturing techniques.

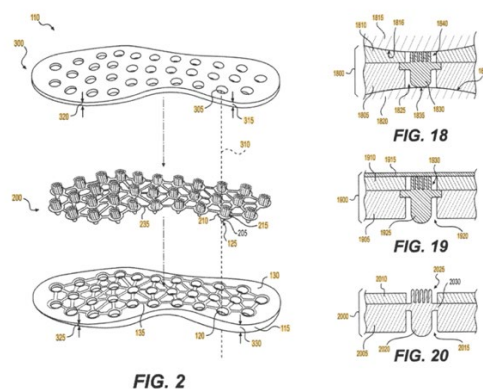
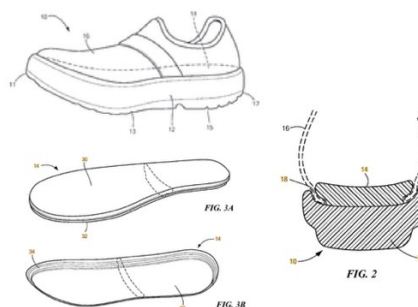


FIG. 2
Patent: US 7650707 B2

Figure 16

Patent examples Nike Inc., US 7,650,707 B2. Figures compiled from the United States Patent and Trademark Office; layout by the author



Patent: US 2019/0125030 A1

Figure 17

Patent examples OOFOS LLC, US 2019/0125030 A1. Figures compiled from the United States Patent and Trademark Office; layout by the author

Overall, this limited patent landscape indicates significant opportunity for original, pickleball-specific innovation. At the same time, it requires careful attention to avoid replicating protected mechanical structures, traction arrangements, or midsole geometries established in other court-sport patents. My design direction therefore prioritizes developing new solutions that address the distinct movement patterns of pickleball athletes, rather than relying on adaptations of existing technologies.

State-of-the-Art and Future Graphics, Color, and Logo Application

Current pickleball footwear often adopts natural tones and low-saturation color palettes, following the visual language of training shoes. While these colors communicate performance reliability, they tend to lack the energy and individuality that reflect today's growing female athlete community.

Recent trend reports from WGSN and Coloro (2025–2027) indicate a clear shift toward vibrant, high-energy hues and emotionally driven color narratives. Tones such as Luminous Blue, Pop Pink, and Energy Orange represent optimism, confidence, and empowerment — values increasingly tied to women's sports and identity.

In my design direction, I aim to introduce a more expressive and energetic color strategy that reflects the movement, speed, and optimism embedded in pickleball culture. I plan to incorporate bolder, high-saturation hues inspired by WGSN and Coloro's 2025–2027 palettes, using colors such as Luminous Blue, Pop Pink, and Energy Orange to highlight empowerment and individuality in women's sports. To maintain visual balance, I will balance the proportional relationship between warm and cool tones. Using cooler accents to stabilize warm, high-energy hues and create a refined performance aesthetic for modern female athletes.



Figure 18

Color trend translation from industry forecast to product direction. Top: WGSN & Coloro 2025–2027 Color Forecasts. Bottom: current market colors versus future bold tones (e.g., Pop Pink, Energy Orange). Images compiled by the author from WGSN / Coloro and brand references

Current pickleball footwear graphics remain visually conservative, closely resembling traditional training shoes. Most existing models feature neutral mesh

uppers, clear panel divisions, and simple visual layering, prioritizing performance function over aesthetic identity. While these designs work well for breathability and durability, but lack a strong visual identity or emotional connection for female athletes.

Emerging design directions, however, point toward bolder and more integrated aesthetics. Future footwear graphics emphasize 3D-structured weaves, data-informed patterns, and sculptural geometry that blend seamlessly with form and function. These approaches communicate motion, precision, and modernity, allowing footwear to express both performance energy and individuality.

In my design, I aim to move beyond the visually conservative silhouettes typical of current training-inspired pickleball footwear. Rather than relying on familiar paneling and mesh-based constructions, I plan to develop a more expressive and recognizable silhouette that can stand out on the shelf. This includes exploring integrated forms, visible functional elements, and three-dimensional geometry that communicates performance technology rather than hiding it. The goal is to create shoes that not only perform well, but also capture attention, reflect personality, and give female athletes new ways to express themselves.



Figure 19

Current and future design trends in pickleball footwear graphics. Images compiled and organized by the author.

Current branding in pickleball footwear primarily emphasizes bold and highly visible logos, often placed prominently on the lateral side or heel to enhance brand

recognition during play. This approach mirrors the marketing-driven aesthetics seen in tennis and training shoes, where visibility is prioritized over subtlety.

However, branding is now evolving toward low-profile and structurally integrated applications, where logos become embedded, molded, or stitched into the material rather than printed on the surface. This shift reflects a broader movement in performance footwear toward minimal, gender-neutral design language, material storytelling, and emotional expression through form and texture rather than overt symbols.

In my design direction, I plan to create a pickleball footwear logo that aligns with this emerging trend toward. Rather than relying on large, surface-printed marks, the logo will be applied in a low-profile manner, such as being molded into the midsole, embossed into the upper, or integrated as part of a stitched structural detail. This approach maintains brand identity while supporting a cleaner, more modern aesthetic.

Current Branding



Future Branding



Figure 20

Current and future design trends in pickleball footwear branding. Images compiled and organized by the author

Physiological Demands

Pickleball is a sport that combines quick reaction, endurance, and repeated bursts of energy. During play, female athletes experience continuous cardiovascular and muscular demands.

As shown in Figure 17, for players aged 20–30, average heart rate in pickleball is only about 5–10 beats per minute lower than in tennis. For older players, the two sports show almost the same heart rate levels. These findings suggest that for younger players, pickleball is not the easy or leisurely activity it is often perceived to be, but a high-intensity, competitive sport requiring strong aerobic capacity and muscular endurance.

The average peak heart rate for 20 years old pickleball players is about 155 bpm, which equals roughly 78% of the age-predicted maximum heart rate ($HR_{\max} = 220 - \text{age}$) (American Heart Association, 2024). According to the Cleveland Clinic (2024), exercising at 70–85% of $HR_{\max}$ corresponds to a vigorous-intensity aerobic zone, where breathing becomes rapid and continuous play demands high cardiovascular effort (Cleveland Clinic, 2023).

For a 30-year-old athlete, the average heart rate of 150 bpm equals about 79% $HR_{\max}$, indicating a similar vigorous-intensity load. Maintaining this effort over long rallies or matches adds constant stress to the heart and lower-body muscles, reinforcing the need for footwear that reduces fatigue.

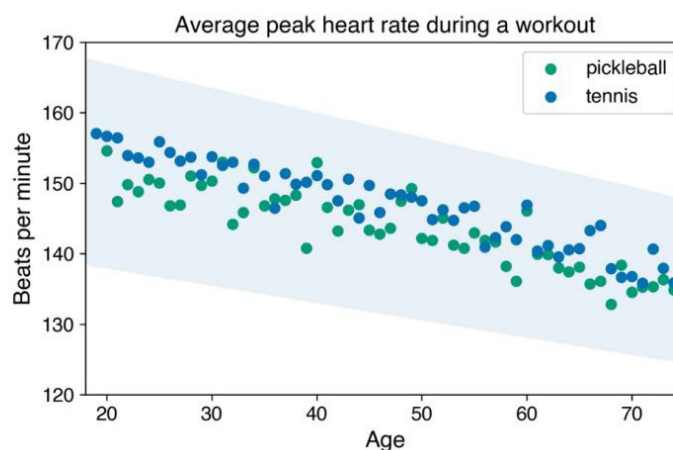


Figure 17

Average peak heart rate in pickleball players by age group. Source: Apple Heart & Movement Study (2024), via American Heart Association LinkedIn post.

Muscularly, the lower body plays the biggest role during pickleball play. The glutes, quadriceps, and calves generate most of the power for lateral cuts, lunges, and quick forward steps, often leading to early fatigue (PB5star, 2025). Rapid acceleration

and deceleration require the calf muscles to contract eccentrically to control braking, while the Achilles tendon absorbs repeated tension. Over time, this repetitive loading limits blood flow in the lower legs, causing swelling, tightness, and delayed-onset muscle soreness (DOMS).

Female athletes are particularly affected due to lower muscle mass, smaller calf volume, and lower venous return efficiency compared to men (JOOLA, 2024). These differences make recovery slower and increase the need for footwear that enhances circulation and offloads tendon stress. Therefore, shoes designed for female pickleball players should integrate responsive cushioning, anatomical arch support, and post-play recovery zones to minimize fatigue and restore blood flow after intense play.

Biomechanical Insights

Pickleball involves quick acceleration, sudden stops, and multi-directional movement within a small court. These movements require both traction and balance control.

Female players also have specific anatomical characteristics that affect performance. On average, women have a wider hip-to-knee angle (Q-angle) and narrower heels, which increase the risk of knee valgus and ankle instability. A greater Q-angle means the knees tend to rotate slightly inward during movement, placing uneven stress on the joints and surrounding muscles. This can reduce balance control during quick lateral cuts or landings, making stability a key biomechanical challenge for female athletes.

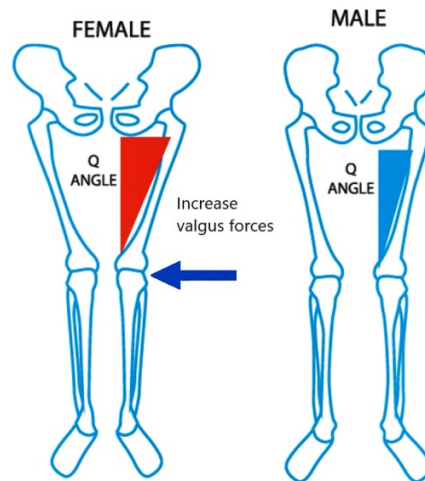


Figure18

Comparison of male and female Q-angles illustrating increased valgus forces in females.

Note. Illustration adapted from a public-domain diagram of lower-limb alignment

Foot-pressure in Figure 19 shows that the highest loads occur at the heel and inner forefoot, with additional pressure concentrated under the big toe area during push-off. These patterns indicate that medial support and cushioning are critical for reducing localized stress and improving comfort during long matches.



Figure19

Foot-pressure distribution during pickleball movement.

Note. Image adapted by author from Pickleball Socks Product Page, Podoks (2025)

Psychological Factors

Beyond physical and mechanical needs, psychological factors also shape athlete performance. Research and player feedback show that female pickleball players value confidence, comfort, and community, but mental strategies also play a major role in

competitive settings. Maintaining focus, anticipation, and composure under pressure allows athletes to make quick decisions and recover from mistakes.

Performance psychology studies have shown that techniques such as visualization, positive self-talk, deep breathing, and pre-point routines can help players sustain concentration and regulate emotions during long rallies (Paddletek, 2024). These approaches are especially relevant in pickleball, where points are short and the pace of play changes quickly. Developing mental resilience enables players to stay calm after errors, reset between serves, and perform consistently throughout the match.

Psychological comfort not only affects how athletes think and perform but also how they perceive themselves through their gear. When athletes feel confident and emotionally supported by what they wear, their motivation and readiness for competition increase (Herrero et al., 2021). These insights suggest that the emotional experience of wearing footwear is an important dimension of performance psychology.

Personal Reflection

My top strengths from the StrengthsFinder assessment is ideation, maximizer, individualization, relator, and developer (Gallup, 2023) .

The strength of Ideation allows me to generate creative and user-centered solutions for women's pickleball footwear, exploring new possibilities in performance and recovery design. Maximizer encourages me to refine and improve each design iteration through testing and feedback, ensuring that both performance and comfort are optimized. Individualization enables me to understand each athlete's unique biomechanics and preferences, helping translate user interviews into meaningful design directions. Meanwhile, Relator and Developer support collaboration with mentors and athletes, helping me build stronger partnerships and continually grow the project through shared learning.

Additionally, my background in oil painting and sketching enhances my ability to visualize ideas and communicate design intent clearly. This artistic foundation

strengthens the creative process, allowing me to quickly express form, proportion, and concept during ideation and prototyping.

This project also contributes significantly to my professional growth within the sports and performance design industry. It provides hands-on experience with the full innovation process — from research and athlete insights to material exploration and concept development. Collaborating with mentors and professionals gives me a clearer understanding of how athlete-centered products evolve from concept to market. Through this experience, I will develop practical knowledge in performance footwear innovation and learned how design can enhance both function and identity for female athletes.

Finally, this project serves as a flagship portfolio piece, demonstrating my ability to combine research, creativity, and technical understanding — which will strongly support my future applications for roles in footwear design industry.

Golden Circle

Why

My interest in women's sports footwear began with my own experience growing up wearing men's basketball shoes that never fit correctly. That early discomfort made me aware of how design affects movement and confidence. Today, many women athletes still encounter similar challenges, relying on footwear that does not fully support their biomechanics or performance demands. My core motivation is to empower women athletes by creating footwear that supports how they actually move, enhances performance, and helps prevent injuries. Allowing them to feel capable, confident, and truly represented in sport.

How

Addressing the unmet performance and comfort needs of women athletes begins with a research-driven process grounded in real user insights. Interviews, on-court observation, and performance testing help reveal movement patterns, pain points, and specific biomechanical challenges. These findings then guide the exploration of

materials, cushioning strategies, and structural solutions, forming an iterative prototyping cycle that continuously integrates athlete feedback and performance data.

What

This design direction focuses on creating women's sports footwear that balances function, style, and inclusivity. The aim is to support women's performance and confidence through products that reflect their specific biomechanics and comfort needs. The work developed in this thesis represents the first step toward that broader goal, applying this philosophy to the design of women-focused footwear and establishing a foundation for continued exploration within the performance and sport design industry.

Mentor

Name: Evan Lok

Role & company: Senior Footwear Designer/Under Armour

Proof of their commitment

Re: UO SPD Capstone Mentorship Inquiry

📧 汇总 😊 ⏪ ⏩ ↺



○ Evan Lok <elok913@gmail.com>

2025年11月10日 星期一 下午12:27

收件人: ✅ Gigi Chen

You haven't previously corresponded with this sender.

Use caution with links and attachments. Learn more about this [email warning tag](#).

[Report Suspicious](#)

Hi Gigi,

Thanks for considering me for your Capstone mentorship. I remember you and your project. Great thinking and execution of your spring plate concept. It would be my pleasure to serve as one of your mentors through your Capstone. Let me know how soon you would like us to have your first initial check-in.

I will be out of town next week from 11/13- 11/19, after that my calendar should be pretty open. Let me know if there is a date after I return that works best for you and I will do my best to accommodate.

Best,

Evan

Name: Brad Winn

Role & company: Sport Performance Engineer/Nike

Proof of their commitment

Mentorship of Gigi Chen

汇总 表情 回复 转发



○ brad winn <bradjameswinn@gmail.com>

2025年11月19日 星期三 下午3:22

收件人: ● Vanessa Preisler; ● Gigi Chen

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Report Suspicious

Hi Vanessa,

I've met with Gigi and have agreed to help mentor her during her final year thesis/capstone project. She presented a thorough overview and we are planning to meet in person on December 4th. Please let me know what other administrative items I need to take on to make this official.

Thanks!
Brad

Name: Deyu Kong

Role & company: Senior Footwear Designer/Anta

Proof of their commitment

Subject: Mentor Confirmation for Gigi Chen – UO Sports Product Design

汇总 表情 回复 转发

2025年11月17日 星期一 下午5:51



○ 孔德毓 <KongDeYu@anta.com>

收件人: ● Gigi Chen



全部下载 · 预览全部

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Report Suspicious

Hello,

My name is Deyu Kong, and I am a senior footwear designer at ANTA with 7 years of experience in the sports product/footwear industry.

I am confirming that I have agreed to serve as an industry mentor for Gigi Chen throughout her thesis process in the Sports Product Design program at the University of Oregon.

I will meet with Gigi monthly and provide guidance as needed until the completion of her graduate thesis.

Best regards,

Deyu Kong

Senior footwear designer

ANTA

User Research Goals

The goal of this user research is to build a clear and evidence-based understanding of the needs of women who play pickleball, so that the design of the footwear system can directly respond to real performance challenges. To achieve this, the research combines background research, on-court observation, an online survey, and direct conversations with athletes. Each method contributes different types of insight, including contextual, behavioral, quantitative, and experiential.

The online questionnaire provides user insights related to playing frequency, court type, footwear preferences, pain points, and recovery habits, while observations and meetings offer more detailed insight into movement behavior, stability needs, and real-time challenges during play.

Overall, the purpose of all research activities is to identify the functional, biomechanical, and recovery needs that are most important to women athletes. These findings form the foundation for defining the performance requirements of the outdoor shoe and indoor shoe, as well as the comfort and relief needs that guide the design of the recovery slide.

Survey Questions

1. How often do you play pickleball?

- ☐ Every day
- ☐ More than 3 times a week
- ☐ 1–2 times a week

☐ A few times a month

☐ Occasionally (recreational / social play)

2. Where do you mainly play?

☐ Outdoor (concrete / asphalt)

☐ Indoor (wood floor / gym)

☐ Both

3. Do you choose different shoes for different courts?

☐ Yes

☐ No

☐ I've never paid much attention / I just wear the same pair

4. What do you value most when choosing pickleball or training shoes? (Select all that apply)

☐ Lightweight / agility

☐ Traction / grip

☐ Stability / lateral support

☐ Cushioning / impact protection

☐ Breathability

☐ Durability

☐ Aesthetic design / style

5. What shoe weight do you prefer during matches?

☐ The lighter the better (for speed)

☐ Slightly heavier feels more stable

☐ No preference / depends on the court

6. Is your shoe-weight preference different between training and matches?

☐ Lighter shoes for matches, more stable for training

☐ No difference

☐ Depends on court or personal condition

7. After playing or training, how do you usually relax or recover your feet?

☐ Change into slides or recovery shoes

☐ Stretching / massage

☐ Ice

☐ Other (please specify): _____

8. What are your most frequent foot movements during pickleball play? (Select all that apply)

☐ Quick stops and starts

☐ Lateral moves / side shuffles

☐ Forward lunges

☐ Small jumps / hops

☐ Pivots / turns

☐ Split steps

9. After playing, which part of your foot most often feels discomfort? (Select all that apply)

☐ Sole / plantar area

☐ Ankle

- ☐ Toes
- ☐ Top of foot
- ☐ Heel
- ☐ No discomfort

10. What improvements would you like to see in future women's pickleball footwear? (Select all that apply)

- ☐ Lighter and more flexible
- ☐ Better traction
- ☐ More support / anti-torsion stability
- ☐ More comfort and breathability
- ☐ Better fit for women's foot shape
- ☐ More feminine or design-oriented appearance
- ☐ Other (please specify): _____

SWOT Analysis

Outdoor Pickleball Footwear Competitors

Product	Strengths	Weaknesses	Opportunities	Threats
 Selkirk Women's CourtStrike Pro Pickleball Shoes	Upper - Engineered mesh provides good breathability while maintaining targeted support 3D-printed overlays and TPU side structures help with lateral stability during multi-directional play Lacing - Lacing system offers adequate adjustability Midssole - TPU shank provide torsional stability Outsole - Great traction, 4-way grip design for pickleball-specific movements Fit Volume - Comfortable for medium-to-wide feet Weight - Lightweight build enhances agility and reduces fatigue	Upper - Mesh durability is inconsistent; several users mention material breakdown after limited use - Overlays do not fully protect high-wear areas (toe drag, medial forefoot) Lacing - Relaxed lacing easily leads to heel slip or ankle fatigue for some players - Not optimized for women's low-volume insteps Midssole - EVA foam is too dense/hard. Limited rebound and energy return - Cushioning feel firm for lighter female athletes Outsole - Numerous user reports of outsole wearing out quickly—even with limited tournament use Insole - Not optimized for female arch shapes and heel-cup depth - Insole is too basic and lacks cushioning Fit Volume - Toe box may be too wide for many women, reducing containment during lateral cuts	Upper - Design a more durable medial/-forefoot protection specifically for high-wear areas Lacing - Create a more anatomical lockdown system for women (e.g., midfoot cinch, floating eyestay, heel wings) - Integrate asymmetrical lacing to improve containment during aggressive lateral stops Midssole - Develop a lighter, softer, women-specific foam tuned to lower bodyweight and higher deceleration forces Outsole - Redesign the easy wear out zones for pickleball movement Insole - Develop a women-specific molded insole with deeper heel cup and better arch support - Introduce anti-slip or moisture-controlling top cloth for long matches Fit Volume - Develop a better fit-adjustment system that can accommodate both narrow and wide forefoot shapes	Upper - Poor durability reduce consumer trust to purchase the shoes Lacing - Weak lockdown increases the risk of foot shift and potential injuries, especially for female athletes with narrower heels. Midssole - Competing brands offer more advanced foam formulas with better energy return - Hard cushioning may discourage female consumers from purchasing Outsole - Low outsole durability directly impacts brand reputation Insole - Weak insole support leads to discomfort and instability during high-frequency lateral movements Fit Volume - Consumers with normal or narrow feet may avoid purchasing the shoe due to the wide fit
 Skechers Viper Court Pro 2.0	Upper - Synthetic overlays provide added durability and protection Insole - Offers arch support and signals attention to foot health - Removable insole (Arch Fit system) allows for custom orthotics or tailoring to foot arch Midssole - ULTRA GO® is light weight and designed for court-use Outsole - Goodyear® rubber compound offers high durability and grip for court surfaces	Upper "Relaxed Fit" mesh/upper might not provide sufficient lockdown for aggressive lateral cuts Lacing - Lockdown may not be optimized specifically for women's lower volume feet — potential heel slip or instability Midssole - Women players (often lighter body weight) may find foam response less tuned to their biomechanics (less rebound, more stiffness) - The absence of a dedicated torsion plate could mean less torsional rigidity during aggressive lateral moves, which may matter for female athletes with specific biomechanical demands (Q-angle, lateral load) Outsole - While durable, the pattern may not be optimized for the very short bursts and frequent side-to-side in pickleball Fit Volume "Relaxed Fit" is too generous for many women whose feet are narrower, especially in heel/midfoot region, leading to heel slip or less containment	Upper - Develop an upper tailored to female foot morphology (narrower midfoot, lower instep) with adaptive overlays for lateral stability Lacing - Design a women-specific lacing/lockdown Midssole - Develop a women-specific foam tuned to lower bodyweight and higher deceleration forces - Develop a lightweight torsion or stabilization plate Outsole - Develop an outsole pattern tuned for pickleball movement - Design a women-specific outrigger to adapted for lower volume and female movement vectors Fit Volume - Develop a better fit-adjustment system that can accommodate both narrow and wide forefoot shapes	Upper - If the upper fails to lock the foot during lateral moves, user fatigue or injury risk increases Lacing - Without strong lockdown, the shoe may underperform in lateral stops or quick pivoting Midssole - If midssole is too firm or generalised, it may feel unsupportive in long matches or fatigue may set in - Competing shoes with advanced midssole tech (plates, deeper compression zones) could out-perform. Outsole - Too aggressive traction may affect comfort Fit Volume - Poor last/fit leads to containment issues - Consumers with normal or narrow feet may avoid purchasing the shoe due to the wide fit
 New Balance FuelCell 996 v6	Upper - High breathability, mesh + synthetic overlays allow good air flow Heel Padding - Plush heel padding improves step-in comfort Insole - Removable insole allows for custom orthotics or tailoring to foot arch Torsion shank "Famous chicken-foot torsion system" (shank) which "runs through the bottom of the shoe" and contributes to high torsional rigidity Fit Volume - Available in wide widths. Wide toe box and room in forefoot reported (good for toe splay). Lab measurement: 95.1 mm forefoot width vs average 92.9 mm	Upper - Durability concerns: toe guard & mesh degrade quickly under aggressive play/drag Heel Padding - Soft padding may reduce directional precision during lateral cuts - Creates heat buildup around the ankle area Insole - Generic insole not address women's specific arch shape, narrower heel cups or softer cushioning preference Torsion shank - Increased stiffness than average Outsole - Transparent rubber in the forefoot offers visual differentiation but is less durable and can become slippery on wet surfaces Fit Volume - For female-specific fit, forefoot width may be too generous, potentially reducing lateral containment or causing foot shift during quick cuts	Upper - Reinforce high-wear zones (toe drag, medial/lateral edges) with durable overlay + splice mesh while retaining breathability Heel Padding - Design a women-specific heel padding system with targeted cushioning, deeper heel cup geometry, and firmer Achilles pads to secure narrow heels without overheating Insole - Design a women-specific sockliner: narrower heel cup, targeted arch support, cushioning tuned for female bodyweight/surface loads, moisture/heat-management	Upper - If durability issues persist, user satisfaction and brand reputation suffer Heel Padding - Excessive heel padding and a wide heel geometry may cause heel slip for narrow-heeled women, reducing trust in the shoe for high-performance play Torsion shank - The high torsional rigidity may feel too stiff for lighter female athletes, making them prefer more flexible court shoes from competitors Outsole - The transparent forefoot rubber may wear out faster, leading to negative durability reviews and reducing repeat purchases Fit Volume - If fit is too wide, female players will feel less secure in lateral stop, this could reduce trust in shoe for high-performance play.

Indoor Pickleball Footwear Competitors

Product	Strengths	Weaknesses	Opportunities	Threats
 HEAD Motion Pro Women's Pickleball Shoe	Upper - Breathable mesh plus reinforced overlays make the upper light and ventilated "Drift Defense" rubber toe piece to protect high-wear medial forefoot zones Midssole - DynaFoam material: HEAD claims for lighter, responsive foam designed for court movements Outsole - Unique "curved last" outsole shape allows easier toe-ball of foot movement, benefiting forward motion Fit Volume - Wide toe box and generous room in forefoot: good for toe splay and comfort	Upper - Slipper tongue design limits adjustability, which can reduce lockdown in aggressive lateral moves - Wide toe box may be too roomy for narrow-footed female athletes, causing containment issues Heel Padding - Female users with narrower heels experience heel slip or insufficient heel containment Midssole - Review notes slight loss of stability during aggressive lateral moves - Foam-only lateral support offers limited containment and may not be stable enough for lateral cuts Outsole - Curved last outsole reduce lateral base stability compared to traditional flat court shoes Shank - Despite having a shank, reviewers still report instability during heavier lateral push-offs, suggesting the torsion system is not strong enough for aggressive indoor movements Insole - Not women-specific: heel cup and arch profile do not sufficiently match narrower female heel shapes or lower instep volumes Fit Volume - Combined with limited lockdown, this reduces precision during indoor lateral cuts	Upper - Develop a women-specific upper variant: narrower midfoot, lower instep, stronger lockdown strap to compensate for wide last Heel Padding - Design women-specific heel cup and padding system: deeper heel cup, narrower heel flare, optimized cushioning for lighter bodyweight Midssole - Optimize foam density and geometry for women's biomechanics (lighter weight, higher Q-angle) and lateral deceleration loads Outsole - Redesign a flatter base or female-tuned last for lateral stability while retaining forward motion support Shank - Design a full TPU sidewall or cage to reinforce lateral control Insole - Design a women-specific molded sockliner: deeper heel cup, targeted arch support, improved lateral-impact cushioning, and better moisture control Fit Volume - Develop a better fit-adjustment system that can accommodate both narrow and wide forefoot shapes - Create a women-specific last: narrower heel, lower instep, refined midfoot and forefoot width	Upper - Weak lockdown lose credibility among serious players who need containment and abrasion resistance Heel Padding - Poor heel containment in lateral movements may increase injury risk (ankle inversion) and reduce confidence in the shoe Midssole - Foam that is less stable reduce confidence during split-step/stop movements Outsole - Shoe may be perceived as less suitable for serious court movement Shank - Unstable shank may increase injury. Competitive indoor players may switch to shoes with more robust plate/shank systems Insole - Women with narrower heels may experience heel slip, reducing confidence in the shoe during indoor fast cuts Fit Volume - Female athletes who require a secure fit for fast indoor deceleration may avoid this shoe
 Asics GEL-Rocket 11 Women's Indoor Court Shoe	Upper - Synthetic leather boosts lateral stability and containment for indoor court movements Insole - The PU insole provides decent step-in comfort and works well for general indoor sessions Midssole - Features GEL® technology for impact absorption and a stable feel at foot strike Outsole - Wrap-up outsole and outrigger support side-to-side movements; flex grooves provide agility Shank - A TPU TRUSSTIC™ shank that effectively reduces excessive twisting and increases midfoot stability	Upper - Extensive synthetic leather overlays limit breathability, leading to heat build-up in indoor play Insole - Foam compresses quickly and can feel flat during long sessions Midssole - The design emphasises general multi-purpose use; may lack female-specific tuning for pickleball movement - Midssole is a little bit heavy Fit Volume - The shoe is described as "snug" and some users felt the width/forefoot fit may be tight	Upper - Use zoned TPU/mesh reinforcements instead of a full side panel to balance lateral support with breathability Insole - Add perforation zones or moisture-management materials to reduce heat build-up Midssole - Design a midssole foam density and geometry for indoor pickleball players: lighter foam, wider lateral base, quicker side-to-side response Shank - Combine the shank with zoned TPU sidewall supports for stronger midfoot/forefoot containment Fit Volume - Develop a better fit-adjustment system that can accommodate both narrow and wide forefoot shapes	Upper - Limit breathability lead to uncomfortable during training Midssole - Too heavy midssole made female athlete feel less agile Outsole - Too aggressive traction may affect comfort Fit Volume - Consumers with wider feet may avoid purchasing the shoe due to the narrow fit Weight - Extra mass at the foot increases energy cost during stop-and-go indoor movements, leading to faster fatigue accumulation

Recovery Footwear Competitors

Product	Strengths	Weaknesses	Opportunities	Threats
 Selkirk Sport Renew Pickleball Recovery Shoe	- Single-piece molded foam reduces pressure points and provides uniform cushioning for post-pickleball muscle recovery - Easy slip-on design accommodates swelling and makes post-session wear effortless	- Limited lateral structure: one-piece EVA collapses under side load, offering little stability - The one-piece foam construction lacks zoned design, resulting in a fairly generic underfoot feel - Shallow outsole grooves provide minimal traction	- Introduce a dual-density, zoned-foam system that blends soft cushioning with firmer medial/lateral support zones, providing a more refined recovery experience - Redesign the outsole with deeper tread grooves or rubber traction zones to improve slip resistance	Competitors like OOFOS or HOKA offer better foam durability and breathability, attracting serious recovery-focused users.
 Skechers Viper Court Pro 2.0	- Made with OOfoam™, a highly soft, high-rebound recovery foam that reduces impact and offloads joint stress - Rocker-bottom geometry reducing forefoot loading after intense play - Extremely lightweight, reducing fatigue during post-match walking - Great ventilation	- Foam-only sidewalls provide minimal lateral stability; foot can slide during uneven surfaces - Foam durability decreases over time, especially under heavy use - Silhouette may lack visual appeal	Add dual-density zones: plush foam for recovery + firmer medial/lateral support for stability	- The plain overall aesthetic provides little brand identity, making the product less compelling than more expressive recovery designs - Athletes may not want their toe to be seen - Unisex fit skews male may reduce recovery effectiveness for female athletes.
 Nike Mind 001	- Neuro-sensory-driven concept: The spherical outsole geometry provides sensory stimulation underfoot, aligning with neuroscience-informed recovery ideas - Unique "surprise" step-in sensation that enhances user engagement compared to traditional recovery slides - High visual appeal	- Lacks functional flex points: the spherical outsole does not bend naturally at the forefoot, reducing gait comfort - Poor breathability - Footbed becomes uncomfortable and slippery when wet (sweat, shower, pool, or rain) due to the insole material - Recovery effects focus mainly on plantar stimulation, not arch, heel, or toe recovery specific for pickleball athlete - Despite being labeled unisex, the geometry skews toward a male-oriented fit, making it less tailored to women's narrower heel and lower instep	- Introduce toe-specific recovery zones to address pickleball-related forefoot fatigue - Add ventilation channels - Develop a women-specific version that reflects female foot morphology	- Uncertain Nike supply strategy or limited drops may frustrate consumers, making it hard for consumers to consistently access the product - Athletes may not want their toe to be seen - Users may question the traction of the spherical outsole, as the reduced contact area can appear unstable on smooth indoor surfaces - Unisex fit skews male may reduce recovery effectiveness for female athletes.

User Insights Research

To gain a comprehensive understanding of the performance, comfort, and aesthetic needs of female pickleball players, I conducted a mixed-methods research study including in-person interviews, field observation at PPA (Professional Pickleball Association), and an online survey. In addition, an online survey with 62 female respondents, primarily recreational players, was conducted to validate and contextualize the athlete insights at a broader user level.

1. Professional Athlete Insights (In-Person Interviews)

In-person research was conducted primarily at a Professional Pickleball Association (PPA) event, where I interviewed 33 professional female athletes ranked within the world top 100, along with two professional coaches. The interview group included multiple world top-10 athletes and internationally ranked competitors, as well as the coach of the current world No.1 player. To broaden the cultural and regional perspective, I also conducted 10 in-person interviews in China, including a nationally ranked female pickleball athlete and a former Olympic table tennis champion who has transitioned into competitive pickleball.

During the PPA in-person interviews, all the athletes mentioned that they frequently perform sudden stops on both outdoor and indoor courts, which often leads to foot slip and toe-box collapse. Several athlete who primarily plays indoors also noted that indoor courts provide more energy return, causing the ball speed to feel faster and requiring quicker reaction time.

Breathability was another key pain point. Since many athletes play more than three games per day, with each match typically lasting 30 to 50 minutes, heat and moisture build up quickly inside the shoes. This is also why many players bring multiple pairs of shoes to tournaments so they can switch between matches.

In addition, many athletes reported discomfort in the forefoot and plantar area after play, particularly around the pinky toe, big toe, and the plantar surface of the foot. These issues were commonly associated with repeated lateral movements and abrupt stopping actions, which increase pressure on the toes and forefoot during play.

All interviewed athletes also said that they usually change into slides or other shoes immediately after matches, highlighting the importance of post-match comfort

and recovery. The most commonly mentioned recovery behaviors included rolling the foot with a ball and manual foot massage, indicating a shared need for footwear solutions that support plantar relief and physical recovery between matches and after extended periods of play.

Aesthetics were also mentioned by all athletes. They noted that the look of the shoe is an important factor when choosing footwear, especially in tournaments where players are more visible on court. These responses indicate that performance footwear for female pickleball players should balance functional performance with visual appeal.

2. Recreational User Insights (Online Survey)

To complement the athlete interviews and field research, an online survey was conducted with 62 female pickleball players, primarily recreational users. The survey results reinforced several key themes identified through qualitative research, particularly related to comfort, cushioning, lightweight, stability, and breathability.

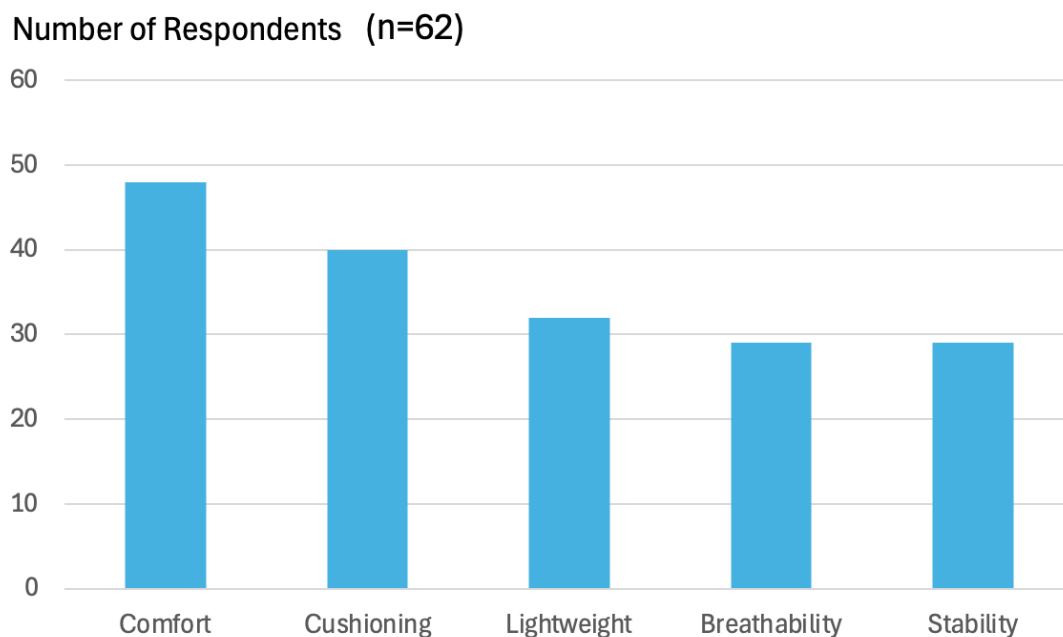


Figure 20

Survey results showing key footwear priorities among female pickleball players (n = 62)

As shown in Figure 20, overall comfort emerged as the most important factor in footwear selection, with 48 out of 62 respondents identifying comfort as their top priority. Cushioning was also a major concern, with 40 respondents indicating that

adequate impact absorption was important and 39 respondents expressing a desire for increased cushioning. These findings suggest that many players experience fatigue or discomfort during play and therefore place high value on midsole protection.

Visual appearance and lightweight construction were also frequently mentioned. 34 respondents indicated that aesthetic appeal influences their footwear choices, while 32 respondents emphasized the importance of lightweight construction, suggesting that users value visual identity and reduced shoe weight alongside functional performance. Stability and support were identified as key performance-related needs by 29 respondents, reflecting the frequent lateral movements and abrupt stops required in pickleball. Similarly, 29 respondents highlighted the importance of improved breathability, noting that heat and moisture buildup inside the shoe negatively affect comfort during extended play.

Finally, approximately one-fifth of respondents (13 out of 62) reported switching footwear between indoor and outdoor courts. This result highlights a meaningful user segment and indicates an opportunity for surface-specific footwear solutions.

Beyond performance, 34 out of 62 user also emphasized the importance of aesthetics for their professional presence. Several mentioned that current pickleball shoes often look like generic tennis or court shoes and lack a strong sense of identity.

3. Recreational Users (Indoor Wooden Court Field Interviews)

During additional field research conducted at indoor wooden courts, many participants noted that traction on wooden floors feels less reliable than on outdoor hardcourt, making it easier to slip during lateral movements and sudden stops. As a result, players expressed a desire for increased outsole grip and slightly more cushioning to improve comfort during indoor play.

Female players also frequently mentioned fit-related issues, particularly a preference for wide toe box designs. Several players reported experiencing toe discomfort during abrupt stops, noting that their toes often press against the front of the shoe. These insights suggest that indoor pickleball footwear should prioritize improved traction on wooden surfaces, enhanced cushioning, and toe box designs that better accommodate forefoot splay during high-impact stopping movements.

Together, these survey insights validate the qualitative findings from athlete interviews and support the need for pickleball-specific footwear that prioritizes comfort, cushioning, lateral stability, breathability, and user experience across different levels of play.

In addition, I have begun gathering outsole wear photographs to study long-term traction and durability patterns. The sample size is still small, so a full pattern analysis will be conducted once more data is gathered.

Together, these insights outline the core performance and emotional needs of female pickleball players and provide a clear foundation for my design direction. These findings also support the reason for my testing plan, guiding the focus on containment, breathability, cushioning, and biomechanical alignment moving forward.

Outsole and Upper Wear Pattern Analysis

During field research at a Professional Pickleball Association (PPA) event, outsole and upper wear patterns were documented through visual inspection and photographic analysis of worn competition shoes. These observations provide insight into high-wear zones created by pickleball-specific movements, particularly during lateral stops and directional changes.

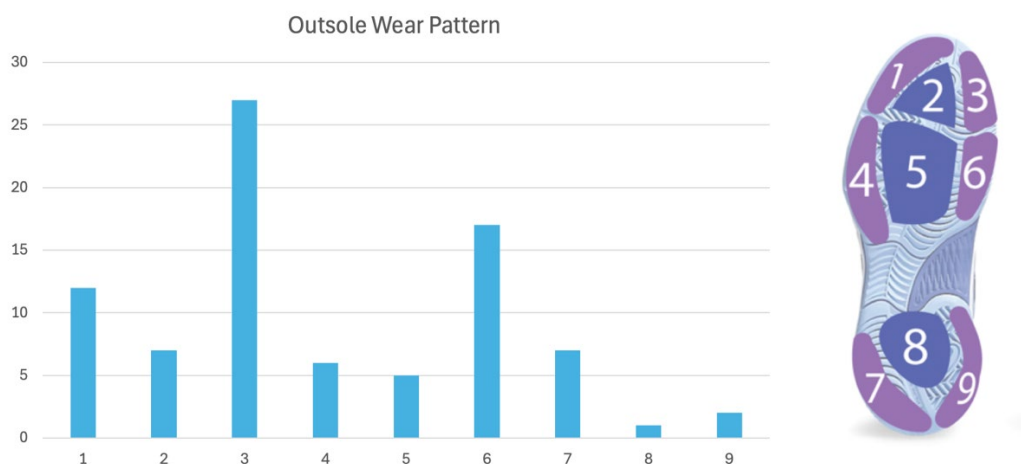


Figure 21

PPA outsole wear pattern (field observation, n=37)

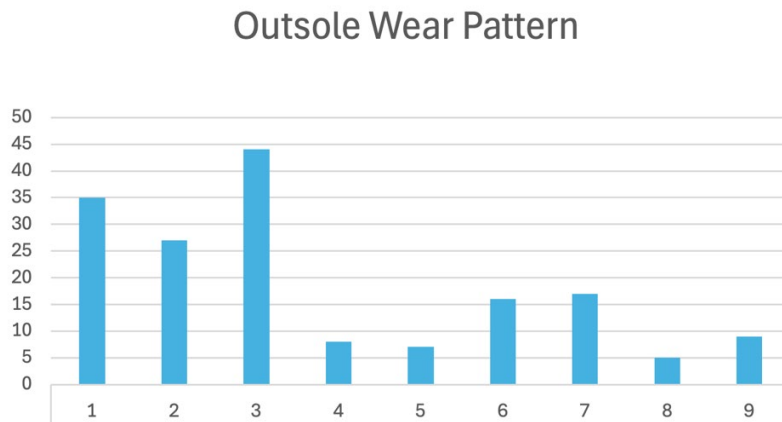


Figure 22

Survey outsole wear pattern results (n = 62)

Analysis of the outsole wear patterns shows that Zone 3, located at the medial forefoot, experienced the highest level of wear across both the PPA field observations and the survey results (Figures 21 and 22). This area corresponds to the region of the forefoot that frequently contacts the court during sudden stopping and deceleration movements, where the medial forefoot is often used to brake and stabilize the body.

Overall, forefoot wear was more prominent than heel wear, indicating that pickleball players rely heavily on the forefoot during lateral movement, quick direction changes, and rapid stops. This finding aligns with athlete interviews that emphasized frequent forefoot loading and toe engagement during play. In the rearfoot region, Zone 7, located on the lateral heel, showed the most common wear pattern.

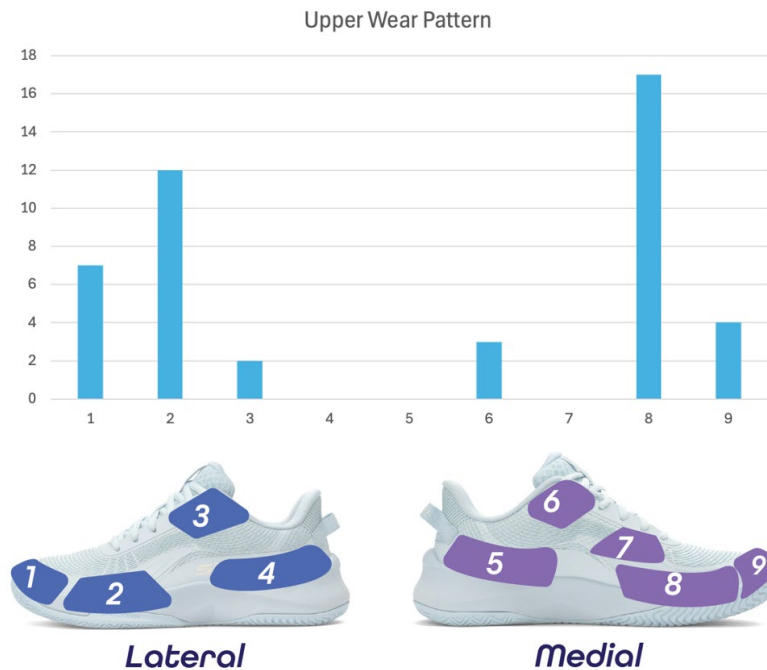


Figure 23

PPA upper wear pattern (field observation, n=37)

Analysis of the upper wear patterns shows that Zone 8, located on the medial side of the forefoot, experienced the highest level of abrasion (Figure 23). This area is frequently in contact with the court during forward lunging and stepping movements, where the inside of the trailing foot often drags against the surface.

The second highest wear was observed in Zone 2, which corresponds to the area around the pinky toe. This finding aligns with athlete feedback reporting discomfort and pressure in the pinky toe region during repeated lateral stops, indicating that this area is exposed to both internal pressure and external abrasion.

In addition to upper surface wear, several athletes also noted that shoelaces tend to wear out over time, particularly during frequent play and competition. This suggests that lace protection and reinforcement should be considered as part of the upper design, especially for high-intensity pickleball use.

Testing Plans

1. Breathability Test

Reference Standard: ASTM D737 (Air Permeability)

Breathability is essential for reducing heat accumulation during outdoor and indoor pickleball play. Two complementary tests were conducted to compare the ventilation performance of competitor shoes.

Test A — Visual Airflow Test

Purpose:

To compare upper airflow pathways and leakage locations across competitor shoes.

Equipment:

Portable handheld fogger and iPhone slow-motion video.

Method:

Insert the fogger nozzle into the shoe opening.

Release fog continuously for 8 seconds.

Record the fog escaping through the upper using iPhone slow-motion mode (120–240 fps).

Observe emergence timing and airflow direction.

Rating Criteria:

Fog emergence time (seconds)

Fog escape intensity (1–5 scale)

Escape locations (toe / quarter panel / tongue area)

Metric:

Faster and stronger fog escape represents higher upper breathability.

Test B — Internal Heat Build-Up Test

Purpose:

To compare the extent of heat accumulation inside competitor shoes during short-duration pickleball activity.

Equipment:

Infrared thermometer and iPhone slow-motion camera.

Method:

The athlete plays pickleball or performs shuttle movements for 10 minutes in each competitor shoe.

Measure in-shoe temperature before and after activity using the infrared thermometer.

Record changes in temperature for comparison.

Metric:

Lower temperature increase (°C) = better ventilation performance.

2. Insole Pressure Mapping Test

Pressure distribution plays a critical role in pickleball performance, particularly during rapid lateral movements, sudden stops, and first-step accelerations. To

understand stability and impact behavior across competitor shoes, a pressure-mapping evaluation was conducted using the Salted Smart Insole system.

Purpose:

To evaluate real-time pressure distribution and stability during key pickleball movements.

Equipment:

Salted Smart Insole + iPhone slow-motion video.

Method:

The athlete performs three representative pickleball movements:

Lateral shuffle (side-to-side)

Forward hard stop (toe containment test)

Split-step into first-step acceleration

The Salted system records real-time pressure data under the heel, midfoot, and forefoot.

Pressure maps are analyzed to identify:

Peak pressure zones

Smoothness of pressure transfer

Number of pressure spikes during movement

Metrics:

Lower peak pressure → better impact absorption

Fewer pressure spikes → better control during cuts and stops

Smoother pressure transfer → more stable movement flow

Medium and controlled lateral shift speed → optimal lateral stability

Higher overall stability score → better performance potential

3. Stability Test

Stability is one of the most critical performance requirements in pickleball footwear, as athletes frequently perform rapid lateral stops and forward decelerations during play. These movements place high demands on containment, traction, and midsole–upper integration. To evaluate the stability performance of competitor shoes, two controlled tests were conducted.

Test A — Lateral Hard Stop Test

Purpose

To assess lateral containment, traction efficiency, and internal foot movement during sudden side-to-side stops.

Equipment

Court tape markers and iPhone slow-motion video.

Method

The athlete accelerates to full speed laterally.

Performs a sudden lateral stop at the marked line.

External stop distance and internal foot slip are recorded using slow-motion footage.

The athlete provides a subjective stability rating (1–10).

Metrics

Stop distance (cm) — shorter distances indicate stronger lateral braking.

Inside-shoe foot slip (low/medium/high) — reflects containment and upper support.

Overall stop-stability rating (1–10) — athlete's perceived stability.

Test B — Forward Hard Stop (Toe-Box Containment) Test

Purpose

To evaluate toe-box containment, forefoot stability, and forward-stop control during sudden deceleration.

Equipment

Court tape markers and iPhone slow-motion video.

Method

The athlete accelerates forward from the baseline.

Performs an abrupt stop at the tape line.

Slow-motion footage records toe-box collapse and forward foot sliding.

The athlete rates toe-box containment (1–10).

Metrics

Toe-forward foot slip (low/medium/high) — degree of foot movement inside the shoe.

Toe-box deformation (visual level 1–3) — structural support under load.

Forward-stop stability rating (1–10) — athlete's perceived stability.

4. Outsole Abrasion Test

Reference Standard: ASTM D3514

Equipment:

Surface Abrasion Tester

Method:

Cut 3 × 3 cm outsole samples from competitor shoes.

Mount each sample onto the abrasion testing machine.

Run abrasion cycles until the first visible wear appears.

Repeat the procedure for three trials per shoe to ensure consistency.

Metric:

Number of abrasion cycles until first visible wear

More cycles = more durable outsole material.

5. Outsole Thickness Test

Purpose:

To compare rubber thickness at key wear zones and evaluate durability potential in competitor shoes.

Equipment:

Digital calipers

Method:

Use digital calipers to measure rubber thickness (mm) at each target zone, including heel, lateral forefoot, and toe.

Metric:

Greater rubber thickness = higher durability potential, particularly in areas subjected to frequent stops and pivoting.

6. Recovery Slide Circulation Test

Test A — Thermal Circulation Assessment

Purpose:

To compare post-play circulation improvement between competitor slides using thermal imaging.

Equipment:

Smartphone thermal-imaging app / FLIR ONE camera

Method:

Record baseline thermal images of the athlete's foot 5 minutes after play.

Athlete walks for 10 minutes in the competitor recovery slide.

Capture post-walk thermal images using the same angle and distance.

Compare heat increase in key zones: toes, forefoot, arch, and lower leg.

Metrics:

Thermal intensity increase (visual scale 1–5)

Overall foot-warmth rating (1–10)

Test B — Perceptual Recovery Assessment (Athlete Feedback)

Purpose:

To evaluate athletes' perceived comfort, support, and recovery effectiveness after post-play use.

Equipment:

Perceptual rating form / 1–5 Likert scale

Method:

Athlete wears the recovery slide for 10 minutes after training or match play.

Athlete completes a 1–5 rating assessing comfort, support, fatigue relief, and stability.

Athlete provides short written feedback on pressure points, relaxation level, and overall recovery feel.

Metrics:

Overall comfort (1–5)

Arch & heel support (1–5)

Underfoot pressure relief (1–5)

Perceived muscle-fatigue reduction (1–5)

Walking stability (1–5)

“Recovery effectiveness” overall rating (1–10)

7. Recovery Slide Anti-Slip Test

Slip resistance is important for keeping athletes safe when using recovery slides. This test measures how much force is needed to make the slide start slipping on a controlled ramp surface.

Purpose:

To measure the slip resistance of recovery slides on an adjustable incline without risking athlete injury.

Equipment:

Adjustable incline ramp,

Force gauge, Tape markers, Spray bottle, iPhone slow-motion video

Method:

Place the recovery slide on the ramp under dry conditions.

Attach the force gauge to the heel strap area or inside the shoe.

Pull the slide upward at a constant speed until slipping begins.

Record the peak force (N).

Repeat the test on a wet surface using light spray.

Conduct three trials per condition and calculate average force.

Metrics:

Peak force required to initiate slip (higher = better slip resistance)

8. Recovery Slide Anti-Slip Test

Purpose:

This test evaluates athletes' aesthetic perception of the recovery slide concept, including its form language, proportions, style, and visual identity.

Equipment:

Concept sketches, 3D renders, and early foam or 3D-printed prototypes.

Method:

Present 2–3 visual concepts during the sketch, render, or early prototype stage.

Ask athletes to rate the visual appeal, shape, proportions, and material impressions of each concept.

Collect short comments and feedback to guide refinement before final prototyping.

Metric:

The collected ratings and feedback guide the selection of the most appealing and suitable design direction.

Benchmark Testing and Results

1. Upper and Midsole Breathability

1.1 Testing Process

To evaluate airflow through different parts of pickleball footwear, controlled airflow smoke tests were conducted. Upper breathability was first evaluated using benchmark pickleball shoes from major brands. To isolate airflow through the midsole, the uppers were temporarily sealed and smoke was applied to the shoe for 10 seconds. Smoke movement through the midsole structure was recorded using photo and video documentation. All shoes were tested under the same conditions and orientation to ensure consistency. All shoes were tested in the same environment and orientation to ensure consistency.

1.2 Data

Breathability performance was evaluated using a relative airflow rating scale from 1 to 5, based on the visibility, speed, and continuity of smoke release (Table 1).

Table 1. Breathability Rating Scale for Smoke Airflow Test

Rating	Smoke Observation	Interpretation
5/5	Immediate and sustained smoke release across the upper	High airflow
4/5	Clear and continuous smoke release with visible airflow paths	Good airflow
3/5	Moderate smoke release	Moderate airflow
2/5	Minimal smoke release with slow dissipation	Low airflow
1/5	Little to no visible smoke release	Poor airflow

Upper Breathability

Skechers > Selkirk > ASICS > HEAD

Controlled airflow (10s) test with photo and video documentation



5/5



4/5



3/5



2/5

Figure 24

Upper breathability benchmark testing results using a controlled airflow smoke test (10s).



Figure 25

Midsole breathability benchmark testing results using a controlled airflow smoke test (10s).

1.3 Data Analysis

Based on upper-only airflow performance, the results ranked as Skechers > Selkirk > Asics = HEAD. Skechers showed the most immediate and sustained smoke release through the upper material, while HEAD demonstrated the least visible airflow. Based on midsole airflow performance with the upper sealed, the results ranked as HEAD > Skechers = Selkirk = ASICS. HEAD showed slightly more visible smoke release through the midsole structure, while the other models demonstrated little to no airflow through the midsole. This suggests that most existing pickleball shoes rely primarily on upper materials for ventilation, with limited airflow through the midsole.

1.4 Results & Key Findings

Table 2. Upper Breathability Benchmark Results

Brand	Breathability Score
Skechers	5/5
Selkirk	4/5
ASICS	3/5
HEAD	2/5

Table 3. Midsole Breathability Benchmark Results

Brand	Midsole Breathability Score
HEAD	2/5
Skechers	1/5
Selkirk	1/5
ASICS	1/5

The results indicate that airflow through the midsole is very limited in most current pickleball footwear. Even when small ventilation openings are present, midsole airflow remains minimal compared to airflow through the upper.

These findings highlight an opportunity to develop a more integrated ventilation system that improves airflow through the midsole without compromising midfoot stability, especially for players who compete in multiple matches per day.

2. Weight Test

2.1 Testing Process

To compare overall shoe weight across benchmark pickleball models, total shoe weight was measured using a calibrated digital scale. All shoes were tested in women's size 8, and each measurement was documented with photographic reference to ensure accuracy and consistency.

2.2 Data

- HEAD – 338g
- Selkirk – 328g
- Skechers – 325g
- Asics – 279g



Figure 26

Benchmark shoe weight comparison for four pickleball models (women's size 8)

2.3 Data Analysis

The results show clear weight differences across benchmark models, with the overall ranking from lightest to heaviest as HEAD > Selkirk > Skechers > ASICS

(Figure 26). These variations appear to be influenced by differences in outsole rubber density, midsole compound volume, and upper material construction.

2.4 Results and Key Findings

Given that many athletes expressed a preference for lighter footwear during interviews, this result highlights an opportunity to reduce shoe weight without compromising containment, durability, or stability.

3. Energy Return

3.1 Testing Process

To evaluate energy return performance, a steel ball drop test was conducted across benchmark pickleball shoes. The steel ball was dropped from a consistent height for all tests, and rebound height was visually recorded using photographic documentation. Each shoe was tested in two conditions: with the original insole and without the insole, allowing comparison of how insole presence and stiffness influence overall energy return.

3.2 Data

- Skechers –1.5 inch
- HEAD + 0 inch
- Selkirk + 0.25 inch
- Asics + 1 inch



Figure 27

Energy return benchmark testing using a steel ball drop test from a consistent height, comparing rebound performance with and without insoles across four pickleball shoes.

3.3 Data Analysis

The results show clear variation in rebound height across different models and test conditions (Figure 27). Shoes tested without the insole generally showed altered

rebound performance, suggesting that insole stiffness and material properties play a significant role in measured energy return during impact.

3.4 Results and Key Findings

The findings indicate that the insole is not a passive component, but a key contributor to energy return performance. Differences in insole stiffness and material construction significantly influenced rebound behavior in the drop ball tests. These results highlight an opportunity to reposition the insole as an active performance element, rather than a purely comfort-focused insert, particularly for pickleball players who rely on quick reactions and repeated stopping movements.

4. Linear and Rotational Traction

4.1 Testing Process

To evaluate traction performance under pickleball-specific movement conditions, linear and rotational traction tests were conducted on a wooden indoor court surface. All tests were performed under consistent surface and loading conditions and documented using video recording.

Linear traction was measured by applying a controlled horizontal pulling force to the shoe until slip occurred, while rotational traction was measured by applying a controlled twisting force to simulate pivoting and directional changes. Each shoe was tested three times, and average values were calculated for comparison.

4.2 Data

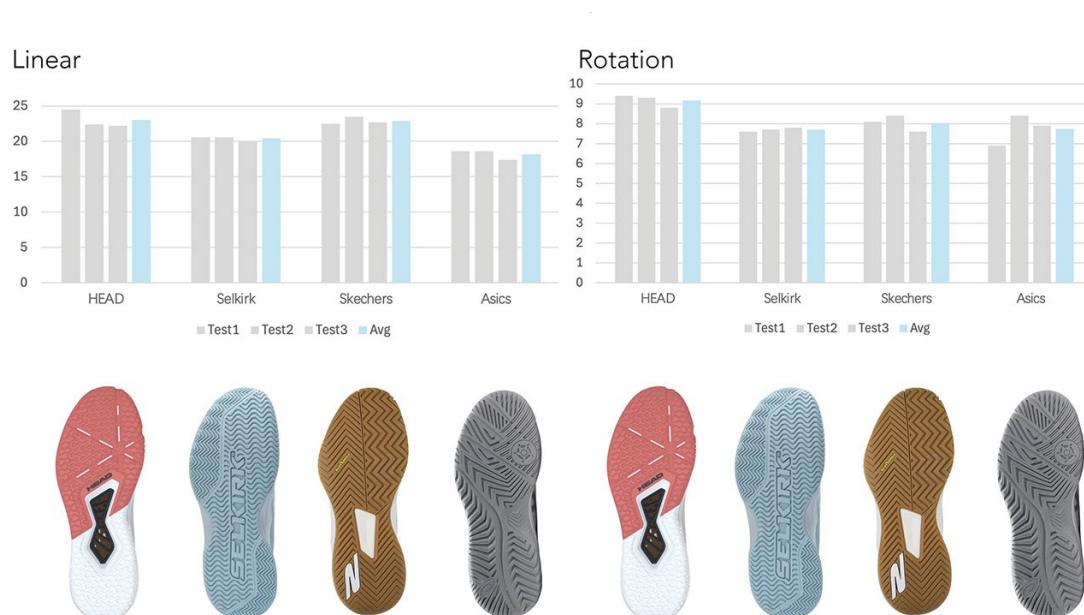


Figure 28

Linear and rotational traction benchmark testing results conducted under consistent surface and loading conditions.

4.3 Data Analysis

For linear traction, three of the benchmark models recorded average values above 20, while the ASICS model showed comparatively lower linear traction performance (Figure 28).

For rotational traction, the HEAD model demonstrated higher average resistance to rotational slip, while the remaining models clustered within a similar performance range. This suggests that outsole pattern and rubber compound choices influence rotational control differently than straight-line grip.

4.4 Results and Key Findings

The results indicate that traction performance varies depending on movement type, rather than following a single “more grip is better” pattern. Although the ASICS outsole uses a uniform rubber compound, changes in forefoot tread direction resulted in a noticeable increase in rotational traction force.

This finding suggests that outsole geometry and tread orientation can significantly influence traction behavior, even when material properties remain constant. It highlights an opportunity to tune traction performance through movement-specific outsole pattern design, rather than increasing overall grip uniformly across the outsole.

5. Bending Stiffness

5.1 Testing Process

To evaluate bending stiffness in benchmark pickleball footwear, a test was conducted to mimic a three-point bending stiffness setup commonly used for footwear evaluation. Each shoe was positioned on two support points, and a downward force was applied at the midfoot region until bending occurred. All tests were performed under consistent conditions and documented using video recording.

5.2 Data

- Selkirk – 225N
- HEAD – 160N

- Skechers – 146N
- Asics – 114N

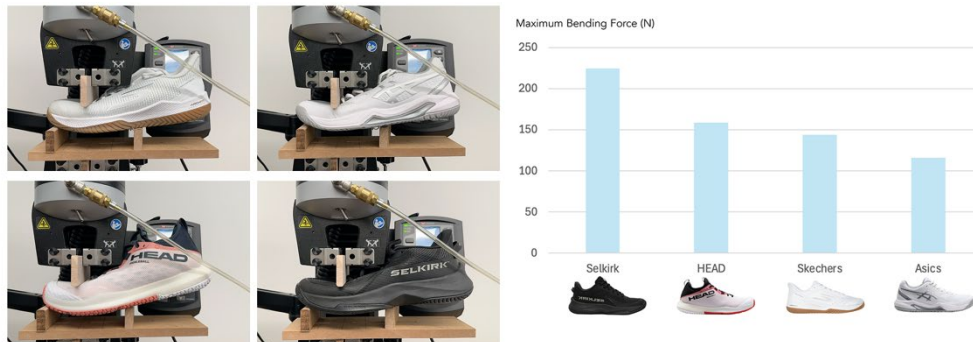


Figure 29

Bending stiffness benchmark testing results using a three-point bending setup

5.3 Data Analysis

The results show clear differences in bending stiffness across the tested models, with the overall ranking from highest to lowest stiffness as Selkirk > HEAD > Skechers > ASICS (Figure 29). Shoes with a midfoot shank demonstrated higher resistance to bending, particularly through the center of the shoe. In contrast, models with less structural reinforcement showed lower bending force values and greater overall flexibility.

5.4 Results and Key Findings

The findings indicate that a midfoot shank effectively limits bending in the middle of the shoe, increasing overall stiffness. However, current benchmark footwear demonstrates a clear tradeoff between rigidity and flexibility, where increased midfoot stiffness can reduce forefoot flexibility.

These results highlight an opportunity to design a midfoot shank that provides lateral stability without compromising forefoot flex, allowing the shoe to better support pickleball-specific movements such as lateral stops and quick directional changes.

6. On-Court Load & Pressure Analysis

6.1 Testing Process

On-court load and pressure data were collected using pressure-sensing insoles during three pro player live pickleball training matches. The sensors were placed inside athletes' shoes and recorded plantar force distribution throughout real

gameplay, including lateral movement, stopping, and recovery steps. Data collection was conducted during full-intensity play to ensure realistic loading conditions.

6.2 Data

Force data were analyzed across medial, lateral, and heel regions for both the left and right foot. For each athlete, maximum force (peak load) and average force values were recorded to understand both impact intensity and sustained loading patterns during play.

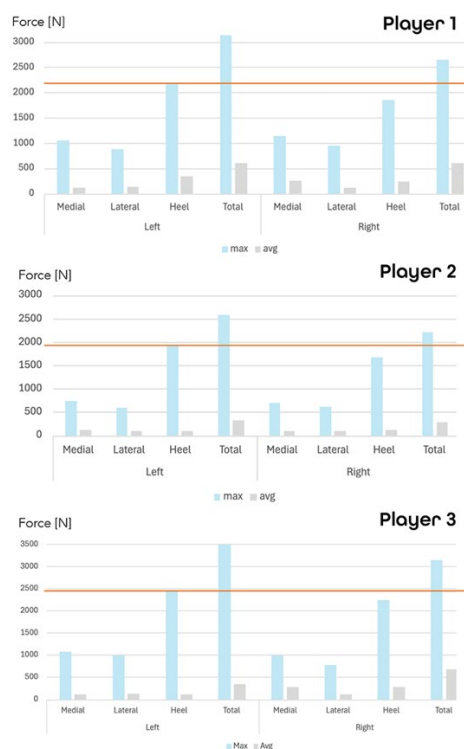


Figure 30

On-court plantar load and pressure distribution during live pickleball play

6.3 Data Analysis

Across all three professional athletes, peak on-court force consistently occurred at the heel region, exceeding both medial and lateral loading on both feet (Figure 30). Athlete feedback further reinforced these findings. Multiple athletes reported that heel cushioning degraded most noticeably after multiple matches, leading to reduced impact comfort over time and increased fatigue during extended play sessions.

6.4 Results and Key Findings

The results indicate that heel impact plays a critical role in overall on-court loading during pickleball, particularly during stopping and recovery movements. These

findings highlight the importance of designing footwear that can sustain high heel loading over time.

7. Athlete Perception: Performance Benchmark Footwear

BENCHMARK TESTING

Athlete Perceived Performance

Context: Feedback was collected after athletes wore each benchmark shoe during light jogging and warm-up activities.

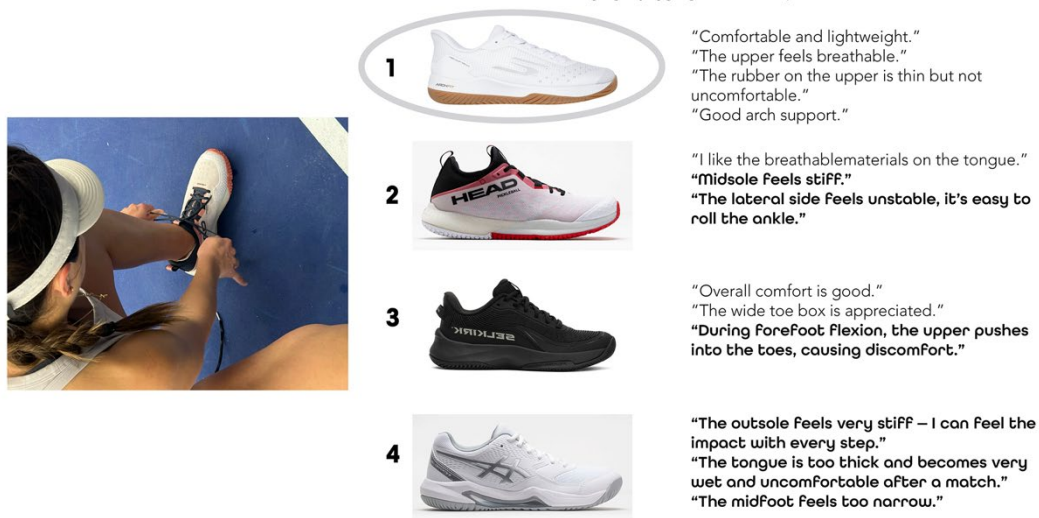


Figure 31

Athlete perceived performance of benchmark pickleball shoes

7.1 Context

Athlete feedback was collected after wearing each benchmark shoes during light jogging and warm-up activities on court. Feedback focused on perceived comfort, stability, fit, and overall on-court feel.

7.2 Key Insights

The Skechers model was described as comfortable and lightweight, with good breathability and adequate arch support. Athletes noted that the thin rubber coverage on the upper did not negatively affect comfort.

The HEAD model received mixed feedback. While athletes appreciated the breathable tongue materials, several reported that the midsole felt stiff and that the lateral side felt unstable, increasing the risk of ankle rolling during movement.

The Selkirk model was generally considered comfortable, and athletes valued the wider toe box. However, some athletes noted discomfort during forefoot flexion, where the upper pressed into the toes.

The ASICS model was perceived as stiff underfoot, with athletes reporting that impact forces were felt more directly. In addition, the thick tongue retained moisture and became uncomfortable after extended play, and the midfoot fit was described as too narrow.

8. Athlete Perception: Recovery Slide

8.1 Context

Post-match feedback was collected from two competitive pickleball athletes after wearing recovery slides immediately following play.

8.2 Key Insights

Athletes emphasized the importance of comfort and recovery immediately after matches, particularly after long periods of play.

Strong arch support was consistently highlighted as a positive feature, contributing to overall comfort during recovery.

Athletes appreciated slides that were easy to put on and suitable for both recovery and shower use.

Massage-like underfoot textures were described as providing a gentle, soothing sensation after matches.

Visual design was mentioned as a secondary concern. While some athletes found certain recovery slides less appealing aesthetically, they still valued their functional performance.

Common pain points included insufficient arch support in flatter designs and a forefoot upper that felt too tight, particularly around the toes. Athletes also expressed a preference for a wider toe box in recovery footwear.

SWOT – Opportunities

SWOT | Outdoor

Opportunities

Upper

- 1 Targeted internal big-toe and pinky-toe protection
- 2 Lightweight and flexible toe bumper
- 3 Quick-drying tongue materials
- 4 Anti-sweat lining
- 5 Targeted ventilation zones

Fit

- 1 Wide toe box
- 2 Enhanced arch support
- 3 Women-specific heel and midfoot lockdown



Midsole

- 1 Improved heel cushioning for repeated impact
- 2 Pressure-informed midsole zoning
- 3 Midsole ventilation channels
- 4 Breathable insole with improved energy return
- 5 Improved midsole heat management

Outsole

- 1 High-wear zone reinforcement
- 2 Multi-directional traction for pickleball movement
- 3 Pivot zones for rotational control

Figure 32

Outdoor Pickleball Shoes SWOT

For outdoor pickleball footwear, several design opportunities were identified based on athlete interviews and field observations.

Breathability and toe protection are important for the upper. Athletes often experience pressure around the big toe and pinky toe during sudden stops and lateral movements. Lightweight and flexible toe bumpers may help improve durability while keeping the forefoot flexible. Quick-drying tongue materials, anti-sweat linings, and targeted ventilation zones may also help reduce heat and moisture during outdoor play.

Fit is another important factor. A wider toe box may reduce toe compression during aggressive movements. Improved arch support and women-specific heel and midfoot lockdown may also help improve stability and overall comfort.

At the midsole level, athletes reported a need for better cushioning during repeated stops and impacts. Opportunities include improved heel cushioning, pressure-

informed midsole zoning, ventilation channels, and breathable insoles with improved energy return.

Finally, outsole observations suggest opportunities for reinforced high-wear zones and multi-directional traction patterns designed for pickleball movements. Pivot zones may also help improve control during rotational movements.

SWOT | Indoor

Opportunities

Upper

- 1 Lightweight and breathable upper materials for indoor heat management
- 2 Reinforced toe protection to reduce discomfort during sudden stops and lateral movements
- 3 Flexible upper construction to improve agility and court feel

Fit

- 1 Wide toe box to reduce toe compression during rapid directional changes
- 2 Enhanced arch support for improved midfoot stability
- 3 Women-specific heel and midfoot lockdown



Midsole

- 1 User-adjustable modular cushioning insole system allowing athletes to select preferred cushioning levels
- 2 Perforated arch ventilation to improve airflow through the midfoot

Outsole

- 1 Non-marking rubber optimized for wood court traction
- 2 Multi-directional traction patterns tuned for indoor pickleball movement

Figure 33

Indoor Pickleball Shoes SWOT

Indoor pickleball shoes require slightly different design considerations due to the wood court surface and faster gameplay.

For the upper, lightweight and breathable materials may help reduce heat buildup during indoor matches. Toe protection may also help reduce discomfort during sudden stops and lateral movements. Flexible upper construction may further improve agility and court feel.

Fit is also important for indoor play. A wider toe box may reduce toe compression during quick directional changes. Enhanced arch support and women-specific heel and midfoot lockdown may help maintain stability.

At the midsole level, a modular cushioning insole system may allow athletes to adjust cushioning based on personal preference. Perforated arch ventilation may also help improve airflow through the midfoot.

For the outsole, non-marking rubber and multi-directional traction patterns may help improve grip and control on indoor wood courts.

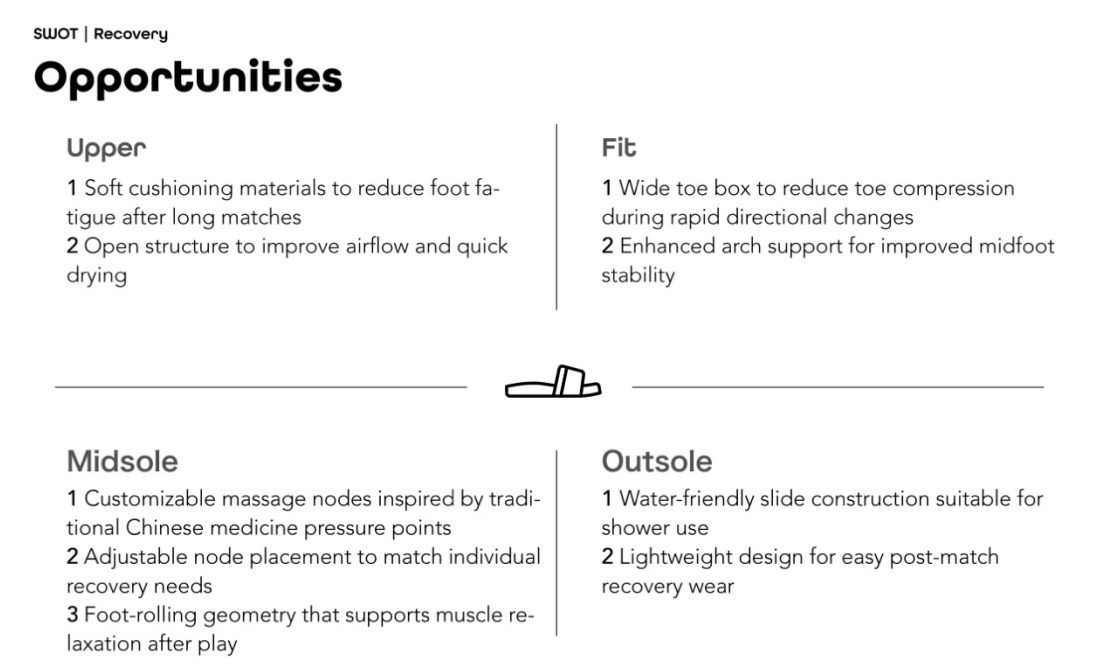


Figure 34

Recovery Slide SWOT

Recovery footwear presents opportunities to support comfort and muscle relaxation after play.

Soft cushioning materials may help reduce foot fatigue after long matches. Open structures may also improve airflow and allow the footwear to dry quickly.

Massage nodes inspired by traditional Chinese medicine pressure points may help stimulate the foot and support recovery. Adjustable node placement may allow athletes to customize the massage experience based on their needs. Foot-rolling geometry may also help relax foot muscles after play.

Finally, lightweight and water-friendly slide constructions may allow athletes to comfortably wear recovery footwear after matches or during shower use.

Together, these opportunities define a recovery slide that translates athletes' existing recovery behaviors into a dedicated footwear solution, balancing comfort, support, hygiene, and functional recovery in a single product.

Brief

PRODUCT BRIEF

SEASON F/W 27

MSRP 150 USD

FOB 28 USD

AURYX PRO

Outdoor Performance Shoe

A lightweight women's outdoor pickleball shoe for competitive players, designed to maximize breathability and support stable lateral movement on hard courts.

Competitors



SKECHERS Viper Court Pro 2.0
\$125

- 4-Way grip design
- Lightweight & Breathable Upper
- Impact Protection for Hard Courts



SELKIRK CourtStrike Pro
\$120

- 4-Way grip design
- Lightweight & Breathable Upper
- Impact Protection for Hard Courts

Key Features & Benefit

1. Lightweight construction

Reduced fatigue over long matches

2. Targeted breathability + moisture management

Improved comfort in outdoor heat

3. Lateral Stability

Provides controlled support during lateral stops and directional changes on hard courts

4. Controlled Traction Outsole

Reliable grip without excessive stickiness

5. Impact Protection For Hard Courts

Impact protection without loss of court feel

Moodboard & Color Palette



Design Metrics

- Airflow score ≥ 5
- Weight reduced by ≥ 20 g compared to benchmark models (US Women's 8)
- Lateral stability score ≥ 4
- Heel ball rebound height reduced by ≥ 10%

Materials & Manufacturing Direction

Engineered Mesh Polyester

Overlays TPU

Foam EVA + Pebax

3D Print

Heat Press

Outdoor Performance Shoes

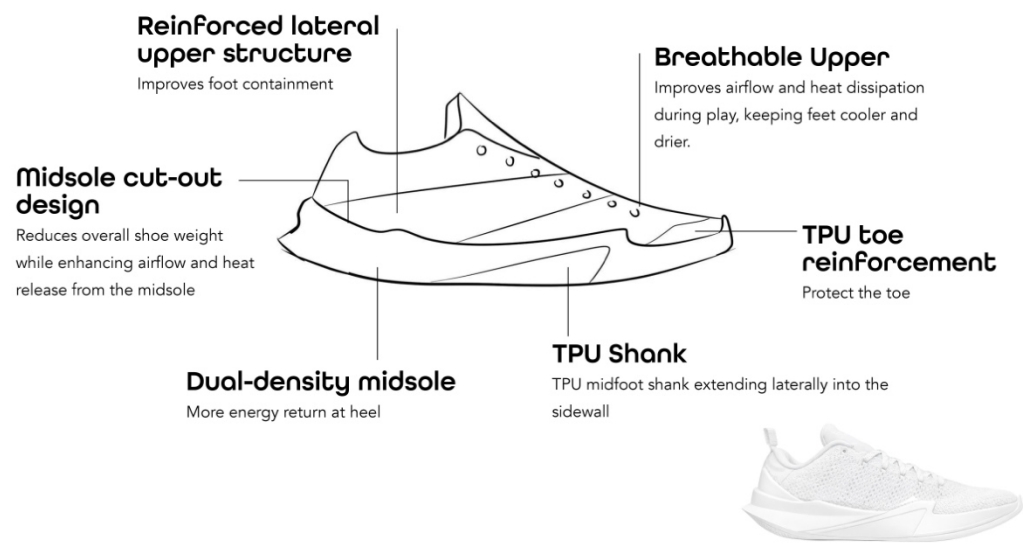


Figure 35

Product brief and creative direction for the AURYX Swift Pro outdoor pickleball shoe

AURYX Pro –Performance Shoe

The AURYX Swift Pro is designed as a lightweight women's outdoor pickleball shoe for competitive play on hard courts. The product brief focuses on maximizing breathability while providing stable lateral support during frequent side-to-side movements and sudden stops. The creative direction emphasizes airflow-driven upper construction, minimal overlays, and a clean, performance-oriented visual language suitable for outdoor tournament settings.

Performance technology goals for this model include improving airflow and moisture management in the upper, reducing overall shoe weight compared to benchmark models, and enhancing lateral stability without increasing stiffness. Outsole design is tuned for controlled traction on hard courts, prioritizing predictable grip over excessive stickiness to support quick directional changes.

AURYX PLAY

Court Shoe

A lightweight women's indoor pickleball shoe for competitive players, designed to deliver reliable traction on wooden courts while maintaining breathability and secure lockdown.

Competitors



HEAD Motion Pro

- Ventilated outsole ports
- abrasion-resistant upper materials
- TPU shank

\$129



ASICS GEL-Dedicate 8

- GEL® cushioning
- Lightweight
- Breathable Upper

\$ 80

Key Features & Benefit

1. Controlled Traction Outsole

Reliable grip on wooden courts without excessive stickiness

2. Targeted breathability + moisture management

Improved comfort in outdoor heat

3. Lateral Stability

Provides controlled support during lateral stops and directional changes on hard courts

4. Lightweight Construction

Reduces fatigue over long matches

5. Impact Protection For Hard Courts

Impact protection without loss of court feel

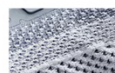
Moodboard & Color Palette



Design Metrics

- Airflow score ≥ 5
- Lateral stability score ≥ 4
- Heel ball rebound height reduced by $\geq 10\%$
- Linear traction force increased by $\geq 10\%$ (N)
- Rotational traction force increased by $\geq 5\%$ (N)

Materials & Manufacturing Direction

Engineered Mesh
PolyesterOverlays
TPUFoam
EVA + Pebax

3D Print



Heat Press



Indoor Court Shoes

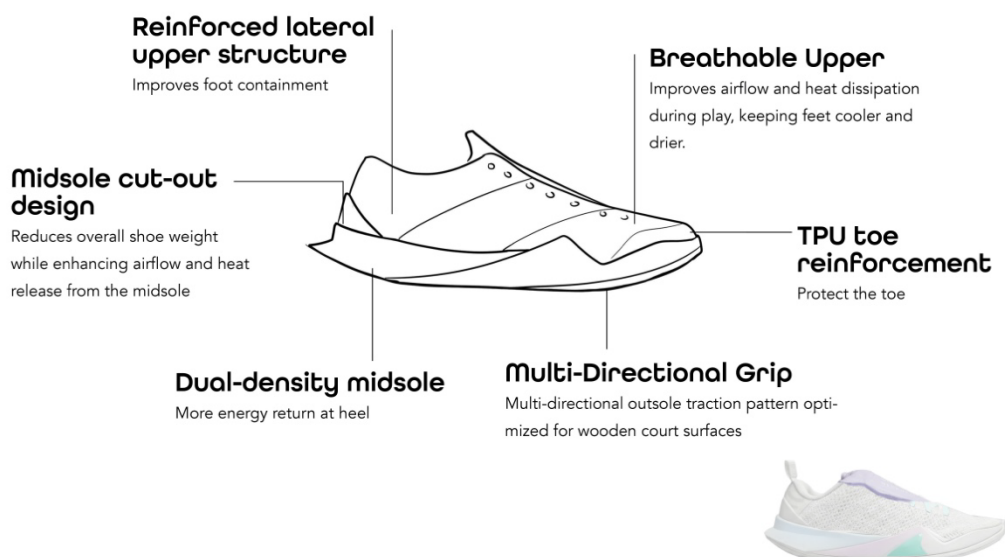


Figure 36

Product brief and creative direction for the AURYX Court indoor pickleball shoe

AURYX Court —Court Shoe

The AURYX Court is developed for female pickleball players who primarily compete and train on indoor wooden courts. The product brief centers on delivering reliable traction on smoother surfaces while maintaining breathability, secure lockdown, and comfort during repeated indoor matches. The creative direction draws from indoor court environments, with a refined material palette and a more controlled, grounded visual expression.

Performance technology goals focus on movement-specific traction optimized for wooden courts, improved lateral stability during stops and pivots, and balanced cushioning to support fast-paced play without sacrificing court feel. Upper construction prioritizes targeted breathability and abrasion resistance, while the outsole pattern is designed to increase both linear and rotational traction based on benchmark testing results.

AURYX RESET

Indoor Court Shoe

A lightweight women's indoor pickleball shoe for competitive players, designed to deliver reliable traction on wooden courts while maintaining breathability and secure lockdown.

Competitors



NIKE Mind 001

- Pre-game / courtside slide
- Rubber pods help provide durable traction.
- Breathable knit upper

\$ 95



OOFOS OOahh

- Impact-absorbing OOfoam™ technology
- Lightweight, flexible & packable for ultimate travel ability
- OOmy footbed geometry, great arch support

\$ 60

Key Features & Benefit

1. Soft Toe Upper Construction

Provides gentle coverage and reduces pressure across the toe area during recovery wear

2. Wide toe box

Reduces pressure on the toes

3. Arch Support

Textured insole stimulates the foot and promotes blood circulation to aid recovery

4. Massage Footbed with Circulation Zones

Reduces fatigue over long matches

5. Modular, Removable Componentss

Detachable footbed for shower use

Moodboard & Color Palette

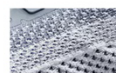


Design Metrics

- Arch support perception score increased by ≥ 1 point
- Toe contact material softness increased by $\geq 10\%$
- Toe box volume increased by $\geq 10\%$
- Wet-condition wear suitability (shower)

Materials & Manufacturing Direction

Engineered Mesh
Polyester



Overlays
TPU



Foam
EVA + Pebax



3D Print



Heat Press



Recovery Slide

Textured massage nodes

Provides gentle stimulation to the sole of the foot, encouraging relaxation and blood circulation during recovery.

Removable antimicrobial liner

Helps reduce odor and bacteria buildup

EVA outer structure

Provides soft cushioning and impact absorption

Arch support

Reduce foot fatigue

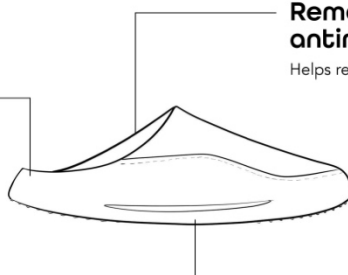


Figure37

Product brief and creative direction for the AURYX Reset recovery slide

AURYX RESET — Recovery Slide

The AURYX RESET is designed as a post-match recovery slide for female pickleball players, addressing comfort, foot relief, and recovery needs immediately

after play. The product brief emphasizes easy wear, reduced pressure on the toes, and support for common post-match recovery behaviors. The creative direction shifts toward softness, simplicity, and a calm visual language that contrasts with performance footwear while remaining consistent with the AURYX collection.

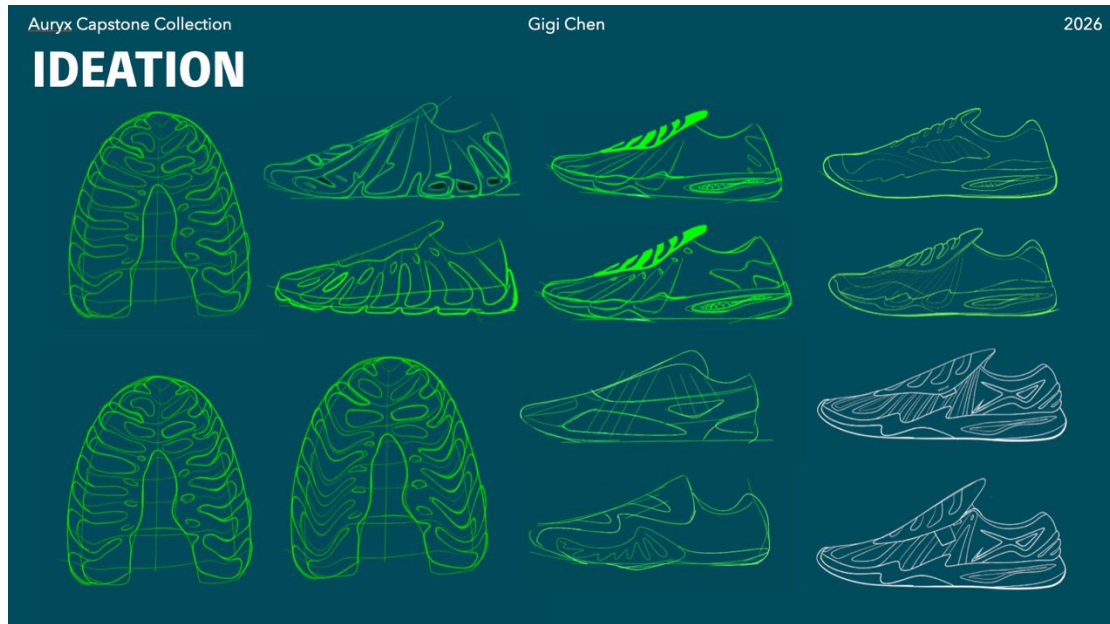
Performance technology goals include increasing perceived arch support, reducing pressure across the forefoot through a wide toe box, and incorporating a massage-inspired footbed informed by athletes' foot-rolling recovery habits. Additional goals include shower-friendly usability through modular or removable components, soft toe-contact materials, and sufficient outsole traction for use across different post-play surfaces.

Ideation

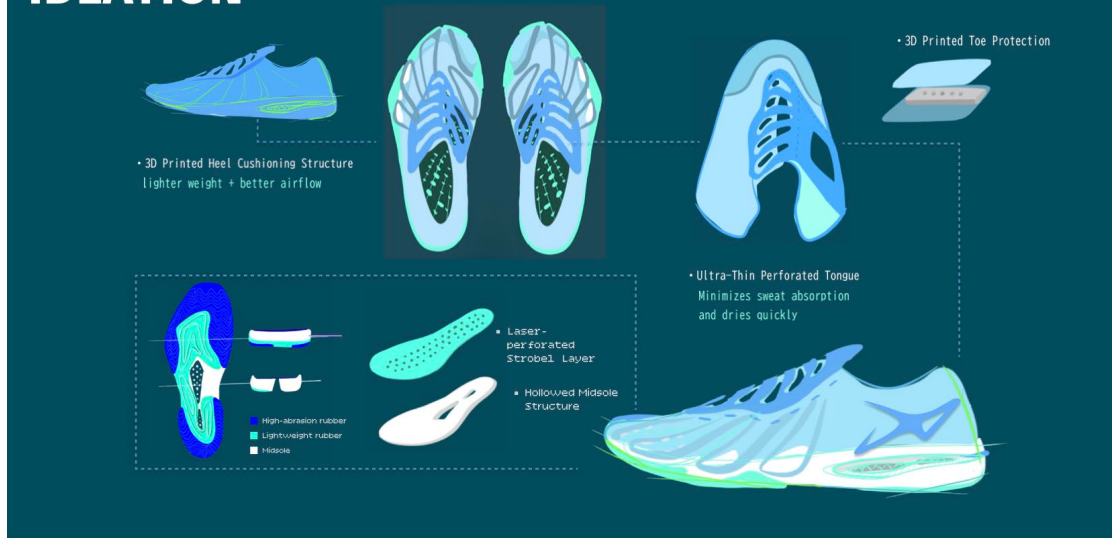
The design language for the AURYX footwear collection was inspired by the fenestrated leaves of the Monstera plant. Native to humid tropical environments, Monstera leaves develop natural openings that allow light, wind, and water to pass through more efficiently while helping the plant adapt to its environment. (University of Connecticut, n.d.).

This biological strategy became the starting point for the project. The concept of creating pathways for airflow and water movement influenced the development of the upper, midsole, and recovery footwear designs. Early sketches explored how similar openings and channel structures could improve breathability, drainage, and comfort for pickleball athletes during training and competition.

These explorations eventually led to the development of the VentCore™ ventilation system and the drainage features used throughout the AURYX collection.



IDEATION



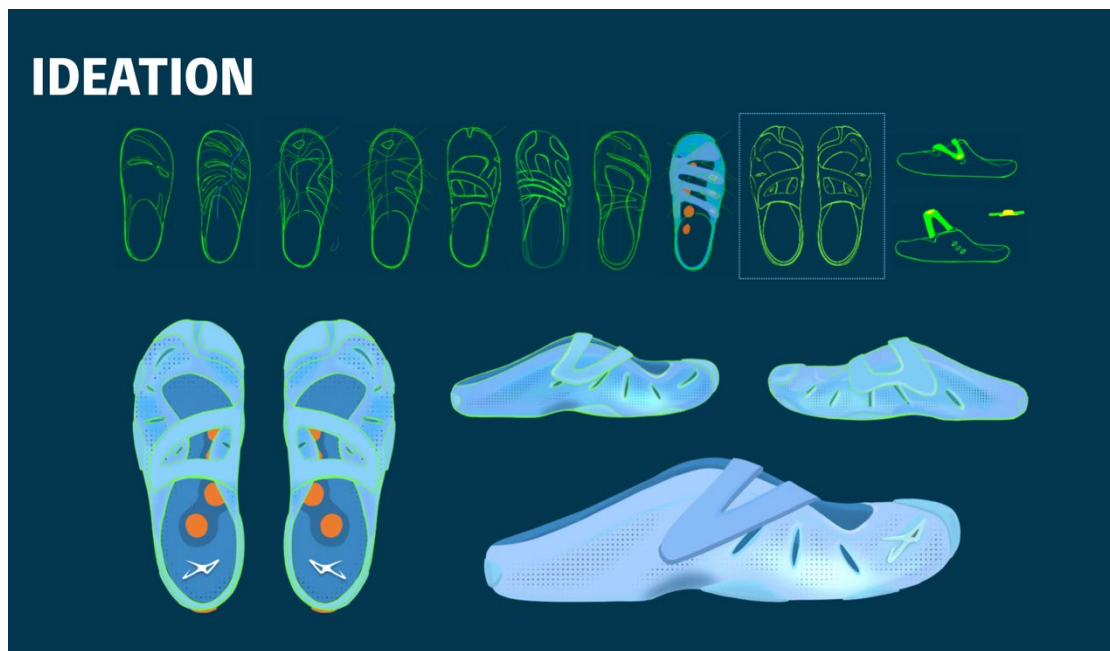


Figure 38

Early ideation sketches inspired by Monstera leaf fenestration

Prototyping Progress

Throughout the project, a series of prototypes were developed to explore, test, and refine key features of the AURYX footwear collection before final production.

A variety of prototypes were created to evaluate the VentCore™ ventilation system, ToeCloud™ toe protection structure, CushSwap™ interchangeable

This iterative prototyping process allowed design ideas to be quickly tested and refined. It also provided a better understanding of material behavior, assembly methods, and how digital concepts translated into physical products. These insights helped guide design decisions throughout the development of the final collection.



2026

PROTOTYPING

AURYX PLAY



PROTOTYPING

AURYX RESET



Figure 39

Prototype development process

New technology testing and validation

1. Works-Like Ventilation Testing

A controlled smoke airflow test was conducted to evaluate ventilation performance through the midsole. To isolate midsole airflow, the upper portion of the shoe was sealed to prevent smoke from escaping through the upper material. A handheld

airflow device was applied to the shoe opening for approximately 10 seconds while smoke movement through the midsole was observed and recorded.

Most benchmark shoes scored between 1/5 and 2/5, indicating minimal airflow through the midsole. The AURYX prototype achieved a 4/5 airflow rating, showing a substantial improvement in midsole ventilation compared with existing pickleball footwear.

This method allowed comparison of airflow behavior across benchmark shoes and the AURYX prototype under the same testing conditions.



Figure 40

Comparison of midsole airflow between the AURYX prototype (left) and benchmark footwear (right)

Table 4. Midsole Breathability Results

Brand / Prototype	Midsole Breathability Score
HEAD	2/5
Skechers	1/5
Selkirk	1/5
ASICS	1/5
AURYX Prototype	4/5

2. Works-Like Energy Return Testing

A drop ball rebound test was conducted to evaluate cushioning and energy return performance. A steel ball was dropped from a fixed height onto the heel area of each shoe while rebound height was recorded using a vertical measurement scale. Each shoe was tested three times under the same conditions to ensure consistent results.

The AURYX prototype showed an average rebound height of approximately 5.0 inches, compared with 4.1 inches for the benchmark shoe.

This result suggests that the midsole cushioning structure improves energy return and impact response compared with existing pickleball footwear.



Figure 41

Drop ball rebound test comparing cushioning performance. The AURYX prototype (left) shows a rebound height of 5.0 in, compared with 4.1 in for the benchmark shoe (right).

3. Works-Like Athlete Perception Testing

Athlete perception testing was conducted to evaluate comfort, fit, stability, ventilation, and overall wear experience of the AURYX prototypes. Testers performed basic pickleball movements including lateral steps, sudden stops, pivots, short runs, and direction changes on an indoor court. After testing, athletes provided qualitative feedback and perception ratings across several categories, including comfort, lockdown, stability, toe protection, and ventilation.

3.1 Works-Like AURYX Pro

Athlete tested the AURYX Pro prototype during quick lateral movements and short running drills. The dual lacing system provided strong lockdown while still allowing flexibility in the upper. Tester reported that the cushioning felt comfortable during movement and that the shoe provided stable support during direction changes. Athlete were also able to feel airflow through the midsole ventilation structure while running, indicating improved breathability compared with typical court shoes.

Comfort and lockdown were rated highly, while stability and ventilation also received positive feedback during testing.

Ratings

Comfort: 4/5

Lockdown: 5/5

Stability: 4/5

Toe protection: 5/5

Ventilation: 5/5

Testing

Athlete wear testing



- Dual lacing system provided reliable lateral support while staying flexible
- Reduced need for bulky TPU structures
- Cushioning felt comfortable during play
- Athletes could feel airflow while running and liked the ventilation design

Comfort 4/5
Lockdown 5/5
Stability 4/5
Toe protection 5/5
Ventilation 5/5

Figure 42

Athlete wear testing of the AURYX Pro prototype during indoor pickleball movements.

3.2 Works-Like AURYX Court

The AURYX Court prototype was tested on an indoor court to evaluate overall comfort, stability, and toe protection during pickleball movements. Tester performed lateral steps, quick stops, and short runs while wearing the prototype. Athlete reported that the shoe felt comfortable overall and that the ToeShield design helped reduce toe impact during sudden stops.

The prototype also provided stable support during direction changes, and tester noted that the traction felt reliable on indoor court surfaces. Athlete responded

positively to the simple and clean design, and several indicated interest in testing the final rubber outsole version in future iterations.

Ratings

- Comfort: 5/5
- Lockdown: 4/5
- Stability: 4/5
- Toe protection: 5/5
- Ventilation: 4/5

Testing
Athlete wear testing

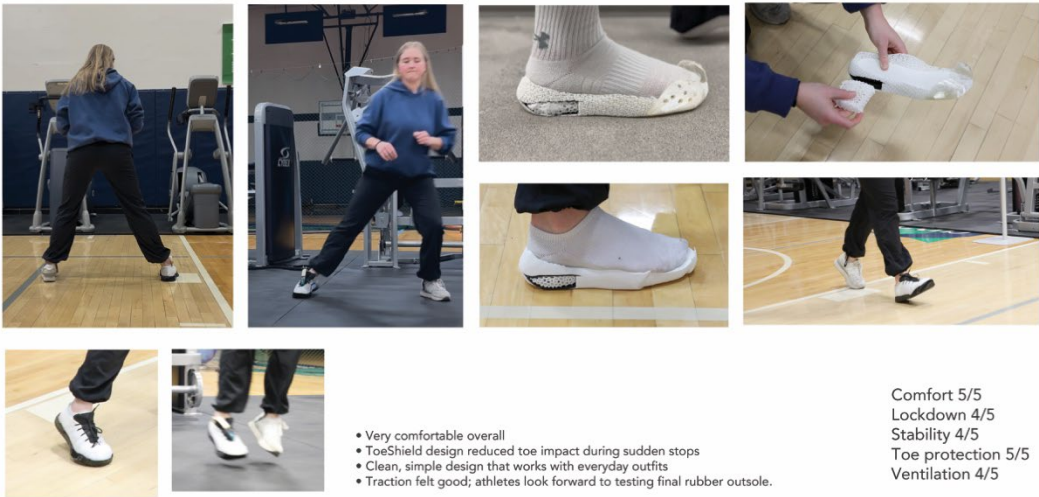


Figure 43

Athlete perception testing of the AURYX Play prototype during indoor pickleball movement.

3.3 Works-Like AURYX Reset

The AURYX Reset recovery slide was tested to evaluate comfort, arch support, and the effectiveness of the adjustable massage node system. Athlete wore the slide after completing approximately 20 minutes of warm-up and 15 minutes of basic training to assess post-play recovery comfort. Tester then walked and moved casually while wearing the slide.

Tester responded positively to the adjustable massage nodes, noting that the ability to reposition them allowed personalized pressure placement. Athlete also reported stronger arch support compared with the Mind001 recovery slide benchmark. The waterproof and shower-friendly design was appreciated for post-match recovery use. Feedback suggested that improving the strap fit could further enhance the overall wrap and security of the slide.

Ratings

Comfort: 4/5

Arch Support: 5/5

Ventilation: 3/5

Testing

Athlete wear testing



- Athletes liked the adjustable massage nodes, allowing personalized placement
- Reported stronger arch support compared to Mind001
- Appreciated the shower-friendly design for post-match recovery
- Suggested improving fit and wrap for a more secure feel

Comfort 4/5
Arch Support 5/5
Ventilation 3/5

Figure 44

Athlete perception testing of the AURYX Reset recovery slide with adjustable massage nodes.

Design Refinement

Feedback collected during the works-like testing phase informed several design improvements across the AURYX footwear collection.

AURYX Pro

Early testing showed opportunities to improve both ventilation and weight reduction. The midsole material was changed from a standard PEBA filament to a foaming filament, which more closely simulates commercial footwear materials while reducing weight.

The VentCore™ system was also expanded. The original design only included side ventilation openings, while the final design added airflow channels through both the sidewalls and outsole. Additional ventilation openings were added to the tongue to further improve breathability.

The tongue retained its lace-cover design, allowing the laces to be stored inside the tongue to reduce abrasion and wear. The tongue was also made thinner to reduce sweat absorption during play. In addition, the original Strobel board was replaced with a mesh Strobel construction to improve airflow through the bottom of the shoe.

AURYX Play

User feedback highlighted the importance of durability, comfort, and toe protection. As a result, the upper material was changed to a combination of suede and mesh to improve durability while maintaining breathability.

The ToeCloud™ protection structure was redesigned to provide full toe coverage and better protection during lateral movements. The insole was also updated with an anti-slip surface to help keep the foot securely positioned inside the shoe during play.

AURYX Reset

Early testing revealed opportunities to improve fit, drainage, and overall usability. An adjustable strap was added to provide a more secure and customizable fit. The movable massage node system was also redesigned to make adjustment easier for users. Additional drainage holes were added to both the upper and footbed to improve water flow and drying performance.

Several prototype iterations were required during development. The first recovery slide prototype could not be successfully printed because some areas were too thin for the selected printing material. As a result, the wall thickness was increased from 2 mm to 5 mm, and the overall dimensions were adjusted to improve fit and manufacturability. These changes led to a successful final prototype.

Final Technology

1. ToeCloud™

ToeCloud is a flexible toe protection structure integrated into the forefoot area of the drop-in insole. Most existing court shoes protect the toe by adding hard TPU on the outside of the shoe. However, when players stop suddenly, the toes mainly contact

the inside of the shoe. ToeCloud focuses on the internal contact area instead of only external protection. The flexible TPU lattice structure helps distribute pressure during forward stops and lunges. Athletes testing showed improved toe comfort during quick stops compared with the benchmark shoe.

2. VentCore™

VentCore is a ventilation structure integrated into the midsole. Small openings in the midsole allow air to circulate through the shoe. The idea came from discussions with multiple athletes during tournaments. Many players play several matches in one day. Athletes often mentioned that their shoes become very hot and feel almost wet after long hours of play. This design helps reduce heat buildup during long matches and improves overall comfort.

FOG testing showed about a 80% increase in ventilation performance compared with the benchmark shoe.

3. CushSwap™

CushSwap is an adjustable cushioning module located in the heel area of the drop-in insole. The heel cushioning pod can be replaced or adjusted based on the user's comfort preference. This design was developed based on feedback from multiple athletes. Different players use their feet differently during play. Some athletes rely more on heel impact, while others use more forefoot movement.

CushSwap allows players to adjust heel cushioning based on their playing style and comfort preference.

4. NodeX™

NodeX is an adjustable massage node system in the recovery slide. This design was inspired by feedback from multiple athletes. Many athletes reported that they like to massage their feet or roll a ball under the foot after training or matches. The nodes can be moved to different positions to target different pressure points on the foot. This feature helps relax the foot after training or matches.

Athlete testing showed stronger arch support and noticeable massage feedback compared with the benchmark recovery slide.

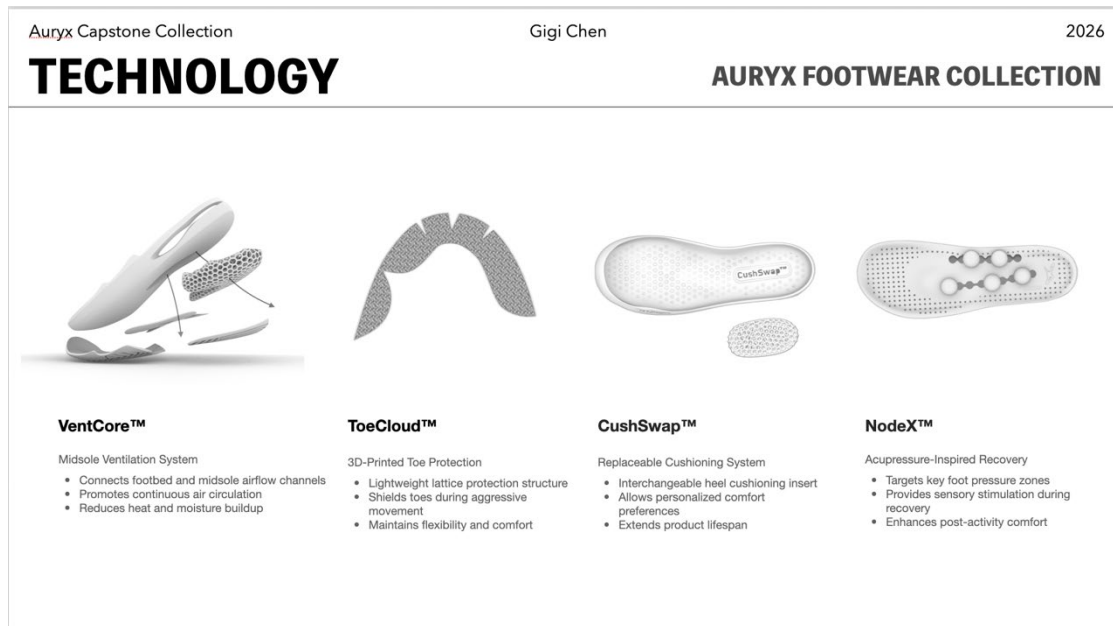


Figure 45

Core technologies developed for the AURYX footwear collection, including VentCore ventilation, ToeCloud toe protection, CushSwap adjustable cushioning, and NodeX recovery systems.

Final Prototype & Validation

AURYX Pro

The final AURYX Pro prototype was evaluated through weight comparison and ventilation testing.

A smoke-flow test was conducted to evaluate the performance of the VentCore ventilation system (Figure 46). Visible airflow was observed through the sidewall and outsole ventilation channels, demonstrating improved air circulation throughout the shoe. These results support the goal of creating a lightweight and breathable performance shoe for competitive pickleball athletes.

Weight testing showed that AURYX Pro achieved a 14.2% reduction in weight compared to a benchmark pickleball shoe (Figure 47). This reduction was achieved through the use of a foaming filament midsole and an optimized ventilation structure.

TESTING



Figure 46

Smoke-flow validation of the VentCore ventilation system showing airflow through the sidewall and outsole ventilation channels

TESTING



Figure 47

Weight comparison between AURYX Pro and benchmark pickleball footwear. AURYX Pro achieved a 14.2% reduction in weight

AURYX Play

The final AURYX Play prototype was evaluated through functional testing of the CushSwap system. Users were able to easily remove and replace the heel cushioning module based on their comfort preferences. The system allows the heel cushioning component to be replaced independently, extending product lifespan and providing a more customizable experience.



Figure 48

Demonstration of the CushSwap interchangeable heel cushioning system

AURYX Reset

AURYX Reset showed faster water drainage due to its open-drainage design and ventilation openings (Figure 49). The benchmark product retained a larger amount of water inside the shoe.

The drying test showed that AURYX Reset dried in 58 minutes, compared to 12 hours and 15 minutes for the benchmark recovery slide. These results suggest that the drainage channels and open structure help remove water more efficiently and improve drying performance.

Athlete wear testing was conducted to evaluate the comfort and usability of the AURYX Reset recovery slide. Participants were asked to wear the slide and interact with the adjustable NodeX recovery system (Figure 50).

Athletes reported noticeable arch support and sensory feedback from the massage nodes. The adjustable strap provided a secure fit, while the movable NodeX elements allowed users to customize pressure placement based on personal preference. Overall feedback suggested that the recovery slide was comfortable to wear and easy to adjust.

Auryx Capstone Collection

Gigi Chen

2026

FAST DRYING PERFORMANCE

AURYX RESET



Water Drainage & Drying Test

Auryx Reset dried in 58 minutes, compared to 12 hours and 15 minutes for the benchmark product.



Figure49

Water drainage comparison between AURYX Reset and a benchmark recovery slide



Figure 50

Athlete evaluation of the AURYX Reset recovery slide and NodeX recovery system

Final Collection Photography

Final photography was conducted to document the completed AURYX footwear collection in use. The photographs demonstrate the intended fit, function, and user experience of each product within the collection. (Figure 51) Athlete participants were included to provide context for how the products are worn before, during, and after pickleball activity.



Figure 51

Final collection photography

Next Steps

A key next step would be gathering feedback from a larger and more diverse group of users. While athlete interviews and prototype testing provided valuable insights, hearing more voices from both athletes and everyday pickleball players would help further refine the designs.

Ultimately, the success of a product depends not only on design intent, but also on how well it meets user needs and whether it is accepted by the market. Future research

could therefore focus on user experience, purchasing preferences, and long-term product evaluation.

If given the opportunity, the project could also move toward manufacturing development to explore production feasibility and commercialization.

Key Learnings This Term

One of my biggest learnings this term was becoming more confident with digital footwear development. Through building three footwear concepts, I significantly improved my 3D modeling speed and became more efficient in Rhino and Gravity Sketch.

I also gained extensive experience with 3D printing. Throughout the project, I spent a large amount of time prototyping, testing, troubleshooting print failures, and refining designs. This helped me better understand how digital models translate into physical products. More importantly, I developed a much stronger understanding of how a shoe is created, from the initial concept to the final prototype.

Another important learning was footwear construction and pattern development. Creating and assembling my own uppers gave me a deeper understanding of materials, fit, and the relationship between upper and sole components.

This project also taught me how to manage priorities within a limited timeline. Designing three footwear products simultaneously required making difficult decisions about where to focus time and effort. I learned that successful design is often about making thoughtful trade-offs rather than trying to perfect every detail.

Finally, I became much more confident presenting my work. Compared to the beginning of the program, I am now able to present complex design ideas with minimal notes and communicate my process more clearly to different audiences. Learning how to answer questions and discuss design decisions in real time was one of the most valuable skills I developed during this project.

Acknowledgements

I would like to sincerely thank my faculty mentors, Susan Sokolowski, Carly Mick , Venessa Preisler, Rachael Volker, and Tom Bonamici for their guidance, feedback, and support throughout this capstone project and my time in the Sports Product Design program.

I am especially grateful to my industry mentors, Evan Lok, Brad Winn, Deyu Kong, Sara Valeri, and Risa Beck, for sharing their expertise and providing valuable advice during the development of this project.

Special thanks to Michael Orlow for his assistance with 3D printing and prototype development.

I would also like to thank the athletes and participants who contributed their time through interviews, testing sessions, and product evaluations, including Tatiana Ruhl, Lingwei Kong , Abbey Calhoun, Clara Brown, and Chaoyi Wang. Their feedback played an important role in refining the final designs.

Finally, I would like to thank Celina Liang for her support during the final photoshoot and documentation process, as well as my family, friends, and classmates for their encouragement throughout my graduate studies.

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