SKYMESH 3D

THE FUTURE OF 3D SCANNING IN MEDICAL DEVICES & PROSTHETICS

FROM PATIENT SCANS TO CUSTOM FITS

Discover how 3D scanning is transforming the future of healthcare—one device, one patient, one breakthrough at a time.

2025

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INTRODUCTION

Healthcare design is evolving—from generic to personal, from reactive to precise. At the heart of this transformation is 3D scanning.

Whether capturing the exact contours of a residual limb for a prosthetic socket or scanning a patient's facial structure for a custom medical device, today's innovators aren't starting from guesswork—they're starting from real data. 3D scanning brings dimensional accuracy to an industry where fit, function, and speed can change lives.

In prosthetics, traditional molding techniques are time-consuming, inconsistent, and prone to human error. Scanning simplifies that process—creating digital twins of the patient's anatomy with millimeter accuracy, ready for digital design, simulation, and 3D printing.

In orthotics, wearables, surgical guides, and dental devices, the story is the same: faster workflows, better fits, and greater comfort. For patients, it means less time in fittings and more time healing. For clinicians and designers, it's a leap forward in capability.

This book explores how 3D scanning is reshaping the medical field—from prosthetic labs and orthopedic clinics to advanced device manufacturing. We'll dive into the tools, the workflows, and the future of personalized care—scan by scan, step by step.

"In medicine, precision isn't cosmetic—it's critical."

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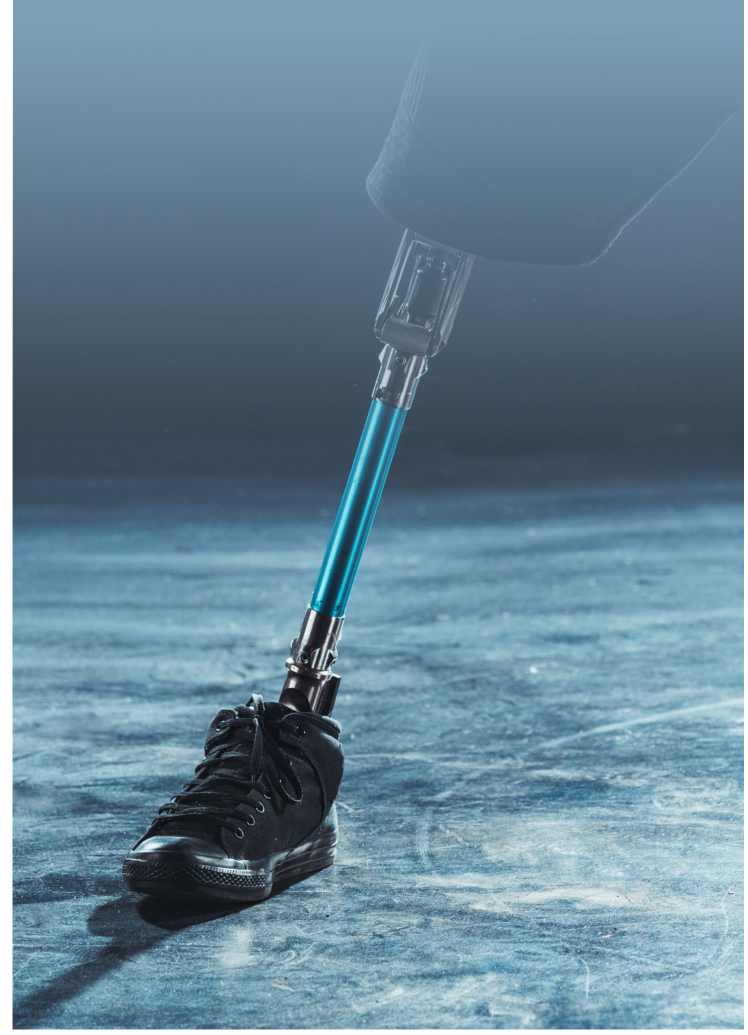
“Every millimeter is a data point—3D scanning reshapes mobility with custom-fitted truth.”



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CHAPTER ONE

WHY HEALTHCARE IS TURNING TO 3D SCANNING

Medical device innovation isn't just about new materials or breakthrough treatments—it's about personalization. And that starts with data. For decades, prosthetics and orthotics were built using manual molds, physical measurements, and clinician instinct. But today's healthcare landscape is shifting toward precision, speed, and repeatability—led by 3D scanning.

From residual limbs to spinal curvatures to cranial asymmetries, healthcare professionals can now capture complex human anatomy in three dimensions—quickly, safely, and non-invasively. The result? Better device fit, faster turnaround times, and improved patient outcomes.

Scans eliminate the guesswork. A scanned socket fits the patient's limb as it actually exists—not as an approximation. An orthotic designed from scan data accounts for every nuance of posture and pressure. A surgical guide built from a 3D scan mirrors the contours of the bone it's designed to assist.

3D scanning doesn't just improve the technical process—it changes the entire care experience. Patients spend less time being cast and recast, and more time receiving treatment. Clinics gain digital workflows, repeatable accuracy, and cleaner data for design and manufacturing.

Whether it's a trans-tibial prosthetic, a cranial remolding helmet, or a dental appliance, scanned data enables a fit that's tailored, efficient, and ready for digital production. In an industry where every millimeter matters, that kind of precision isn't a luxury—it's a necessity.

Modular, Reusable Patient Models

Just like in industrial design, medical scans don't have to be one-off files. A properly captured scan becomes a reusable asset:

- For future adjustments
- For wear-and-tear tracking
- For progress comparisons
- For replacement manufacturing

A patient's limb scan today can be referenced again in six months to check for volume changes. A dental arch scan can be used to print both a temporary retainer and a final appliance. Scanned models become part of a patient's digital health record—accessible, editable, and always up to date.

Speed and Accuracy at the Point of Care

Healthcare timelines are tight. In prosthetics and orthotics, traditional molding takes hours of clinician time and weeks of turnaround. 3D scanning collapses that entire process into a digital workflow that starts with a handheld device and ends in a fabrication lab or printer.

A limb that would take 2–3 castings to fit correctly can now be scanned in minutes, with edits made digitally—no plaster, no mess, no guesswork.

Hospitals, clinics, and device manufacturers using 3D scanning report:

- Fewer refits and remakes
- Higher patient satisfaction
- Faster device delivery
- Lower material and labor costs

"You can't fix what you can't measure. Scanning gives us a precise starting point—every time."

What's Next

In the world of medical design, the difference between comfort and pain is often a matter of millimeters. That's where 3D scanning shines—capturing not just shape, but biomechanical truth. It allows designers, prosthetists, and surgeons to work with the patient's body—not against it.

From scoliosis braces to dental splints to upper-limb prosthetics, the common thread is clear:

real anatomy → real data → real results.

In the next chapter, we'll break down the specific scanning workflows used in healthcare—how clinicians are capturing data in the field, what devices they're using, and how scans flow through design and manufacturing.

"In healthcare, small details drive big outcomes—3D scanning makes them count."

For prosthetists, orthotic designers, and biomedical engineers, this means fewer fittings, faster turnarounds, and devices that actually fit on the first try. What once required casting rooms, weeks of iteration, and physical molds can now be captured in minutes using handheld scanners like the Artec Leo or Peel 3. These scans become the foundation for digital sockets, surgical guides, wearable orthoses, and personalized implants.

They don't just map the body—they give clinicians a way to design with the patient, not just for them. When accuracy, comfort, and performance are built into the workflow, outcomes improve—and patients feel the difference.

CHAPTER TWO

CORE SCANNING WORKFLOWS IN MEDICAL APPLICATIONS

3D scanning in healthcare isn't a single process—it's a toolkit of specialized workflows built to solve real human problems. Whether designing a transtibial socket, customizing an orthotic brace, or modeling a surgical implant, clinicians and device teams rely on precision scans to close the gap between biology and engineering.

In this chapter, we'll explore the most widely used scanning workflows in modern medical applications—and how each integrates into digital design and fabrication pipelines.

Limb Scanning for Prosthetics

One of the most transformative uses of 3D scanning is in prosthetic limb design. Instead of wrapping the residual limb in plaster and waiting for it to cure, clinicians now use handheld scanners to capture exact surface geometry in minutes.

Applications:

- Below-knee (transtibial) sockets
- Above-knee (transfemoral) sockets
- Upper-limb prosthetics
- Cosmetic covers (fairings)

Benefits:

- Eliminates messy casting
- Reduces need for recasting
- Produces scan-ready models for CAD modification
- Improves initial fit and comfort

Example: A prosthetist scans a patient's residual limb with an Artec Eva. The model is digitally adjusted for pressure relief and alignment, then 3D printed into a diagnostic socket—all in less than 48 hours.

Spinal, Cranial & Orthotic Scans

Beyond limbs, 3D scanning plays a major role in orthotic design—especially for conditions like scoliosis, plagiocephaly, or foot misalignment.

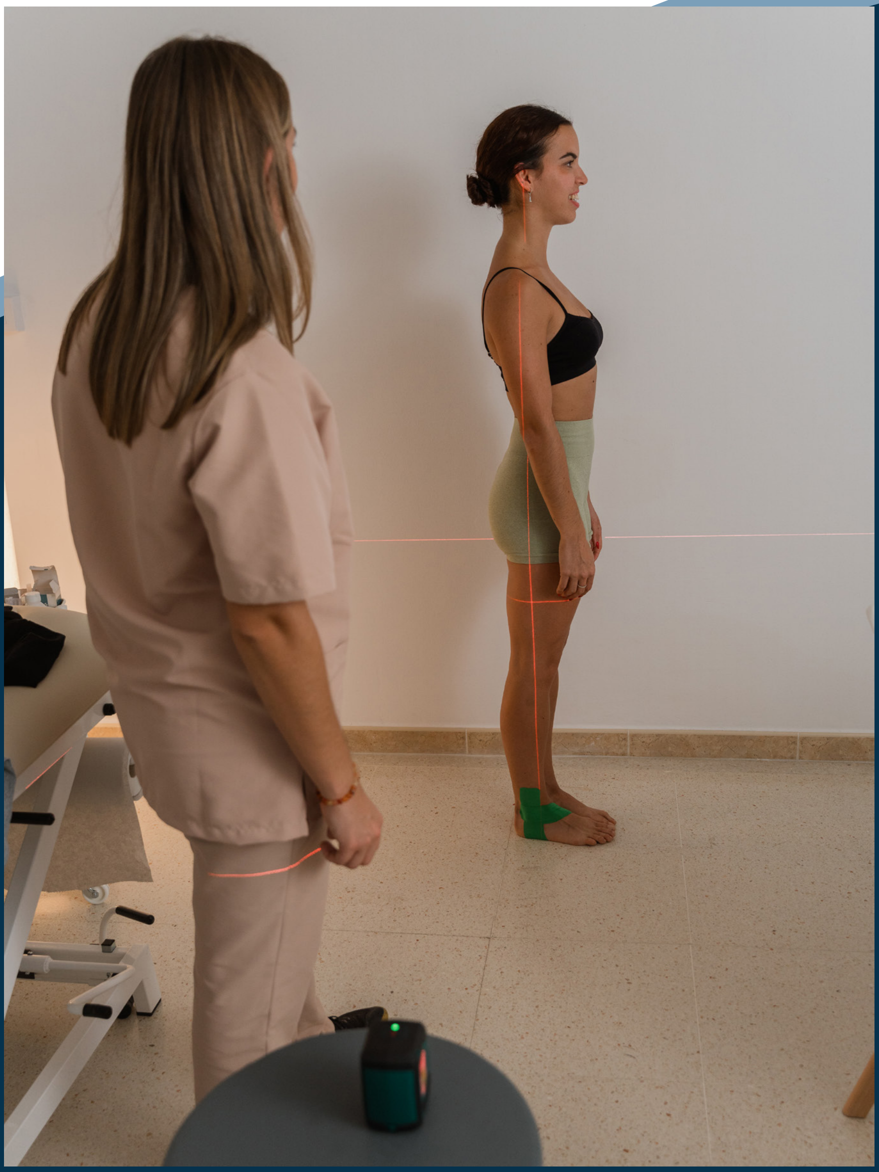
Clinics now use scanning for:

- **Scoliosis braces** (thoracolumbosacral orthosis)
- **Cranial remolding helmets** (for infants)
- **Ankle-foot orthoses** (AFOs)
- **Custom insoles and footwear**

Why it matters:

- Patient anatomy is complex and asymmetrical
- Traditional molding can distort soft tissue
- Scans provide a static, editable record for tracking growth or treatment progress

Example: A pediatric patient is scanned for a cranial remolding helmet. The scan is used not only to fabricate the helmet but to track head growth and symmetry improvement over time.



Spinal, Cranial & Orthotic Scans

Scanning is also used in dentistry, maxillofacial prosthetics, and surgical planning.

Common workflows include:

- Intraoral scanning for crowns, bridges, and retainers
- Facial scans for ocular prosthetics and masks
- Jaw modeling for orthognathic surgery guides

Clinicians often combine scans with CT or MRI to build accurate surgical plans and printed devices.

Real-world scenario: A cancer survivor receives a facial scan for a custom silicone prosthesis. The digital model preserves symmetry and integrates seamlessly with the skin.

Facial & Dental Applications

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Reference Scans for Device Design & Simulation

Not all scans become the final product. Many serve as reference for:

- **Surgical planning**
- **Biomechanical simulation**
- **Implant design & fitting**
- **Medical training models**

A hip replacement designer may scan a patient's pelvis to test implant positioning and movement. A surgeon may use bone scans to print a full-scale model for pre-surgical walkthrough.

Example: A team designing a knee brace scans multiple patients to analyze force vectors and optimize strap placement for comfort and pressure distribution.

Mobile & Field Scanning

Handheld scanners and smartphone-compatible systems now allow clinicians to scan:

- In the field
- In home-health settings
- At rural clinics with limited equipment

These systems upload to cloud-based platforms for remote design and printing—making precision healthcare more accessible than ever.

Example: A field medic scans a trauma patient's limb in a conflict zone using a mobile LiDAR device. The scan is sent to a remote lab to fabricate a protective brace within 24 hours.

Suggested Workflow Snapshot

Type	Hardware	Output	Use Case
Residual limb	Artec Eva / Leo	OBJ, STL	Prosthetic socket design
Spinal brace	Structure Sensor Pro	Mesh + measurements	TLSO orthosis
Cranial helmet	Peel 3	High-res mesh	Infant helmet shaping
Facial prosthesis	Photogrammetry + Eva	PLY, OBJ	Cosmetic reconstruction
Surgical planning	CT + 3D scan	Hybrid model	Guide printing & implant fit

Behind every successful patient fit is a repeatable, precise workflow. That's why clinics and labs are building scanning stations right into their patient experience—eliminating delays and reducing the need for third-party modeling.

Standard flow:

- Scan the anatomy (on-site or remote)
- Import into CAD software (e.g., Fusion 360, Geomagic Freeform)
- Modify digitally for pressure zones, alignment, or clearance
- Export clean mesh for 3D printing, carving, or CNC production
- Fit, test, adjust—and repeat digitally if needed

What's Next

In the next chapter, we'll explore the specific tools of the trade—from structured light scanners to open-source photogrammetry—and how to choose the right combination for your clinic, lab, or R&D environment.

CHAPTER THREE

TOOLS OF THE TRADE – HARDWARE, SOFTWARE & FORMATS

The magic of 3D scanning in medicine doesn't just come from knowing what to scan—it comes from using the right tools to do it efficiently, safely, and accurately.

In clinical and lab environments, hardware must be portable, reliable, and fast. Software has to bridge the gap between raw anatomical data and functional design. And file formats must flow smoothly between scanning, CAD, simulation, and fabrication.

In this chapter, we'll break down the key scanners used in prosthetics and orthotics, the most trusted software in clinical pipelines, and the formats that keep every stage of production talking to the next.

Handheld Scanners – The Frontline Tool in Clinics

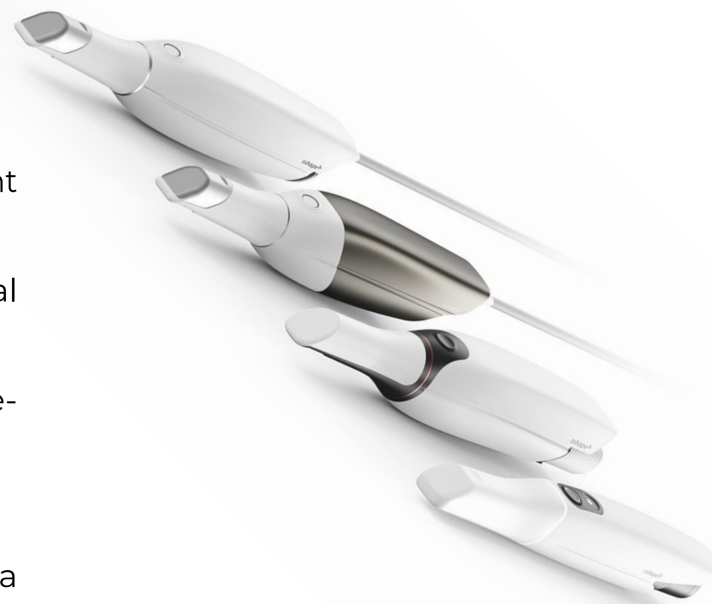
Handheld structured light and laser-based scanners are the go-to for capturing accurate anatomical geometry in a variety of healthcare settings.

Top Picks for Clinical Use:

- **Artec Eva** – Lightweight, reliable, and trusted in orthotic and prosthetic clinics worldwide
- **Artec Leo** – Wireless, real-time feedback, ideal for fast scans and on-site analysis
- **Peel 3 / Peel 3.CAD** – Budget-friendly with excellent body scan accuracy
- **Structure Sensor Pro** – iPad-mounted and mobile, great for fieldwork and pediatric scanning

Medical-Grade Scanning for Surgery & Implants

Some workflows require internal anatomical accuracy or extremely high-resolution scans. That's where advanced imaging and hybrid data come in.



Additional Devices:

- **CT / MRI** – Paired with surface scans for implant alignment or surgical guides
- **Intraoral Scanners** – Used in dental and craniofacial workflows (e.g., 3Shape TRIOS, Medit i700)
- **Photogrammetry Rigs** – Great for full-face or surface-detail capture in ocular/facial prosthetics

In hybrid cases, clinicians align CT/MRI volumetric data with surface geometry using specialized software, ensuring implants and guides precisely match the patient's anatomy.

Software That Brings Scans to Life

After the scan is captured, the next step is turning raw data into a device-ready model. Whether you're prepping for a 3D print, CNC mill, or digital simulation, cleanup and refinement are key.

Common Tools for Post-Processing & Design:

Software	Use	Best For
Artec Studio	Cleanup + meshing	Eva / Leo scan processing
Geomagic Freeform	Organic CAD modeling	Limbs, orthotics, fairings
MeshLab	Open-source cleanup + mesh repair	Budget-friendly, field use
Fusion 360	CAD/CAM design + parametrics	Mechanically integrated devices
Blender / ZBrush	Digital sculpting	Surface smoothing, fine detailing
Mimics Innovation Suite	Hybrid CT/surface workflows	Surgical, cranial, and implant modeling

Best Practices for Medical Scanning Teams

- **Scan posture matters** – Always scan the patient in a position that matches the use case (e.g., weight-bearing, neutral spine)
- **Environment counts** – Avoid cluttered backgrounds and inconsistent lighting
- **Document everything** – Store lighting conditions, scanner settings, and scan time in the patient's file
- **Review in real time** – Use scanners with onboard feedback (like Artec Leo) to avoid reshoots
- **Stay HIPAA compliant** – Ensure all scan data is encrypted and handled according to privacy regulations

What's Next?

Now that you've seen the tools and formats behind medical scanning, we'll turn toward what's coming next—from real-time diagnostics to AI-assisted design, and the growing intersection of 3D scanning and regenerative medicine.

SkyMesh 3D: Precision Scanning for Patient-Centered Design

SkyMesh 3D bridges the gap between human anatomy and digital fabrication. Whether you're designing a prosthetic socket, a cranial helmet, or a surgical model, we deliver high-resolution, clinically relevant scan data optimized for medical workflows.

We collaborate with prosthetists, orthotic labs, and surgical teams to capture what matters most: fit, symmetry, and patient comfort. From scan to simulation, our files are clean, accurate, and ready for integration into CAD software, CAM systems, or 3D printing pipelines—giving you the tools to treat faster, with greater precision and better outcomes.

CHAPTER FOUR

FUTURE APPLICATIONS — FROM SURGICAL SIMULATION TO PERSONALIZED DEVICES

3D scanning in healthcare isn't just enhancing current workflows—it's laying the foundation for a future where treatment is faster, more precise, and deeply personal.

As hardware improves and software becomes smarter, clinicians and designers are gaining the ability to simulate procedures before they happen, deliver custom-fit devices in days, and integrate patient anatomy directly into the design process. This convergence of scanning, AI, and digital fabrication is turning personalization into standard practice.

Personalized Devices, Designed From Scan

The future of prosthetics, orthotics, and wearable medical tech is mass customization. 3D scanning makes it possible to design around the individual, not the average.

- Prosthetic fairings with anatomical symmetry
- AFOs contoured perfectly to a patient's gait and arch
- Helmets molded to infant growth curves
- Respiratory masks designed from facial geometry in minutes

These aren't prototypes—they're rapidly becoming the clinical standard. By starting with accurate scan data, designers skip guesswork and go straight to fabrication.

> What once took weeks of molds and measurements can now be done in a single scan and delivered within 48 hours.

AI-Driven Scan Analysis & Auto-Design

Artificial intelligence is beginning to play a major role in the way scans are interpreted and turned into medical solutions. Emerging tools are using AI to:

- Automatically identify anatomical landmarks
- Suggest optimal brace or implant placement
- Auto-generate socket or helmet designs
- Flag scan anomalies for clinician review

This dramatically reduces design time, eliminates repetitive modeling tasks, and standardizes results across large patient populations—without sacrificing personalization.

Bioprinting & Regenerative Interfaces

As bioprinting matures, patient-specific scans will guide the development of tissue-engineered implants, bone scaffolds, and cartilage replacements. 3D scanning provides the anatomical reference needed to grow replacement parts that fit perfectly.

This opens the door to:

- Bone grafts modeled from pre-injury scans
- Cartilage replacements based on surface geometry
- Tissue scaffolds shaped by pre-operative bone loss

While still in early adoption, these workflows are gaining momentum in research hospitals, orthopedic labs, and regenerative medicine startups.

Real-Time Scanning & On-Site Production

With devices like the Artec Leo and Peel 3, clinicians can now scan and preview models in real time—no post-processing lag, no guesswork. This real-time feedback loop enables on-site scanning, rapid prototyping, and same-day fittings.

- Fit-check sockets can be printed within hours
- On-call adjustments can be made from cloud-synced scans
- Rural clinics can scan and transmit models instantly to remote labs

This decentralization of care makes high-quality outcomes more accessible, especially in low-resource or field-based environments.

Cloud Collaboration & Scan Libraries

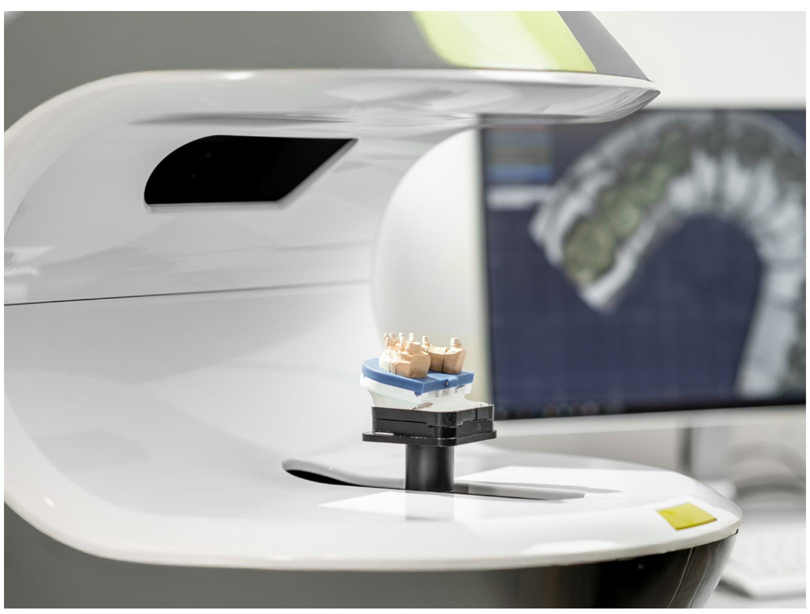
Clinics and labs are starting to build shared libraries of anonymized scans, case templates, and pre-modeled components. These assets can be reused, modified, or versioned across cases—boosting consistency and drastically cutting lead times.

In the near future:

- Remote teams will co-edit prosthetic models live
- Pre-scanned anatomical variants will power simulations
- Scan templates will adapt automatically to new patients via AI
- Scan libraries aren't just references—they're launching pads.

What's on the Horizon?

Emerging Trend	Impact
Scan-to-print automation	From raw scan to fabricated device in a single push
AR surgical overlays	Real-time visualization of anatomical data in the OR
Digital twin patient records	Longitudinal scanning for post-op care & growth tracking
Virtual fitting rooms	Simulated prosthetic fit before physical production
Regulatory-integrated design	Pre-validated models based on scan libraries



What's Next?

In the next chapter, we'll take you into a real-world case study—following the end-to-end journey of a prosthetic design powered by scanning. From initial capture to final fit, you'll see how SkyMesh 3D workflows save time, improve accuracy, and change patient outcomes for the better.

CHAPTER FIVE

SCAN → DESIGN → DELIVER

(CONCEPT DEMONSTRATION)

While this example is fictional, it represents a highly achievable workflow using current tools and processes.

When it comes to patient outcomes, time and precision are everything. This real-world case study follows a fast-moving prosthetic design project from scan to socket—showing how SkyMesh 3D workflows reduce turnaround time, improve fit accuracy, and give clinicians more confidence at every stage.

The Challenge: A Fast Turnaround for a Trans-Tibial Prosthesis

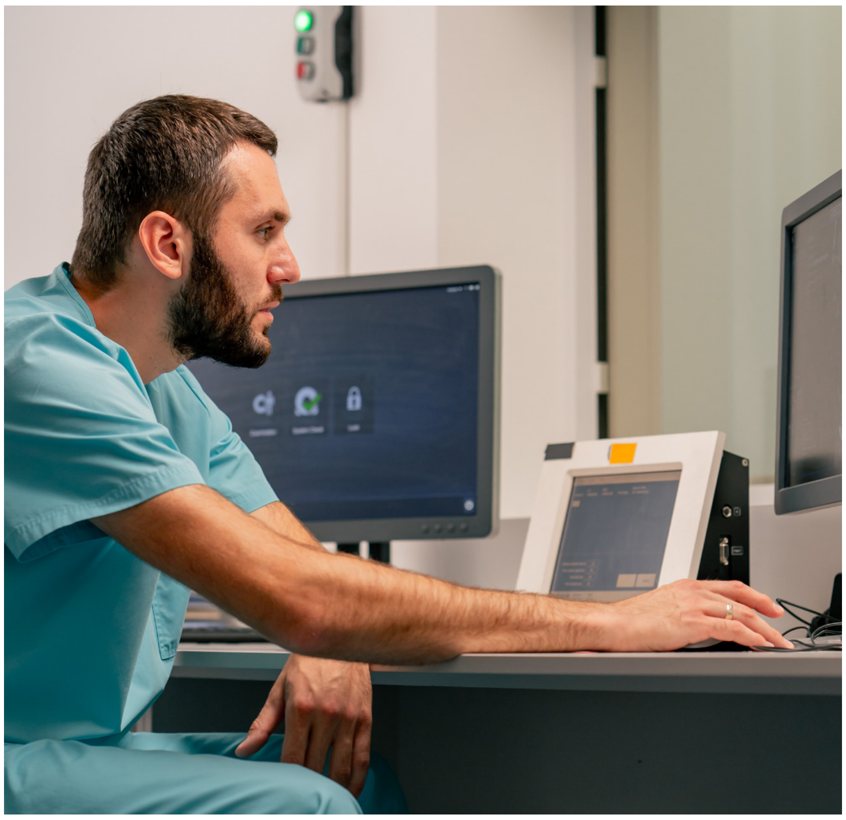
A rehabilitation clinic contacted the SkyMesh team with an urgent request:

A patient needed a below-knee (trans-tibial) prosthesis after emergency amputation. Due to travel limitations and time constraints, traditional casting wasn't viable.

The goal was to:

- Scan the residual limb in a single session
- Design a diagnostic socket digitally
- Deliver a test-fit device within 72 hours

In short—no margin for error and no time for rework.



Step 1: Scanning the Residual Limb

A certified prosthetist used an Artec Leo scanner to capture the patient's residual limb in a neutral seated position. The scan took less than five minutes and captured surface geometry with sub-millimeter accuracy.

- Scanner: **Artec Leo**
- Environment: On-site, natural light
- Output: High-resolution OBJ file
- Notes captured: Limb rotation, pressure points, gait notes

The scanner's real-time display allowed the clinician to confirm capture coverage before leaving the patient—***eliminating reshoots and delays.***

Step 2: Socket Design & Digital Prep

The scan data was uploaded to SkyMesh's cloud system and brought into **Geomagic Freeform** for digital modification. The team:

- Smoothed the mesh
- Applied relief zones
- Added alignment guides
- Exported for 3D printing within hours

A diagnostic socket was printed using medical-grade resin, fitted with a lightweight pylon, and shipped back to the clinic overnight.

Step 3: Fitting, Feedback & Final Device

At the clinic, the diagnostic socket was fitted with minimal adjustment required. The patient reported comfort and mobility during gait testing.

Using feedback from the trial socket, SkyMesh designers made final modifications and sent the completed socket file for fabrication via carbon-composite lamination.

- Fit verified
- No recasting required
- Final delivery: Day 5 post-scan

Results & Impact

Metric	Traditional Process	With SkyMesh 3D
Casting + refit sessions	2-3	0
Socket delivery	14–21 days	5 days
Comfort rating	Moderate	Excellent
Fabrication rework	Likely	None

Key Takeaways

- 3D scanning eliminated the need for molds, plaster, and patient travel
- Real-time scanning saved hours of potential back-and-forth
- The digital workflow improved precision and reduced material waste
- Faster turnaround meant faster rehab and higher patient satisfaction

Wrapping Up

In prosthetics, time delays and fit issues can be more than frustrating—they can be life-altering. With 3D scanning, clinicians and designers gain tools to move faster, work smarter, and deliver devices that truly fit the first time.

SkyMesh 3D helps teams replace guesswork with geometry, and opinion with precision.

THANK YOU

Thank you for exploring the future of medical 3D scanning with us. If you're here, it means you care about what happens when care meets technology—when data becomes design, and every device is built around the individual who needs it.

At SkyMesh 3D, we believe scanning is more than a tool—it's a turning point. A way to move faster, reduce friction, and deliver patient-specific solutions that truly fit. Whether you're designing a prosthetic socket, a scoliosis brace, or a custom surgical guide, 3D scanning gives you a foundation of truth you can build on.

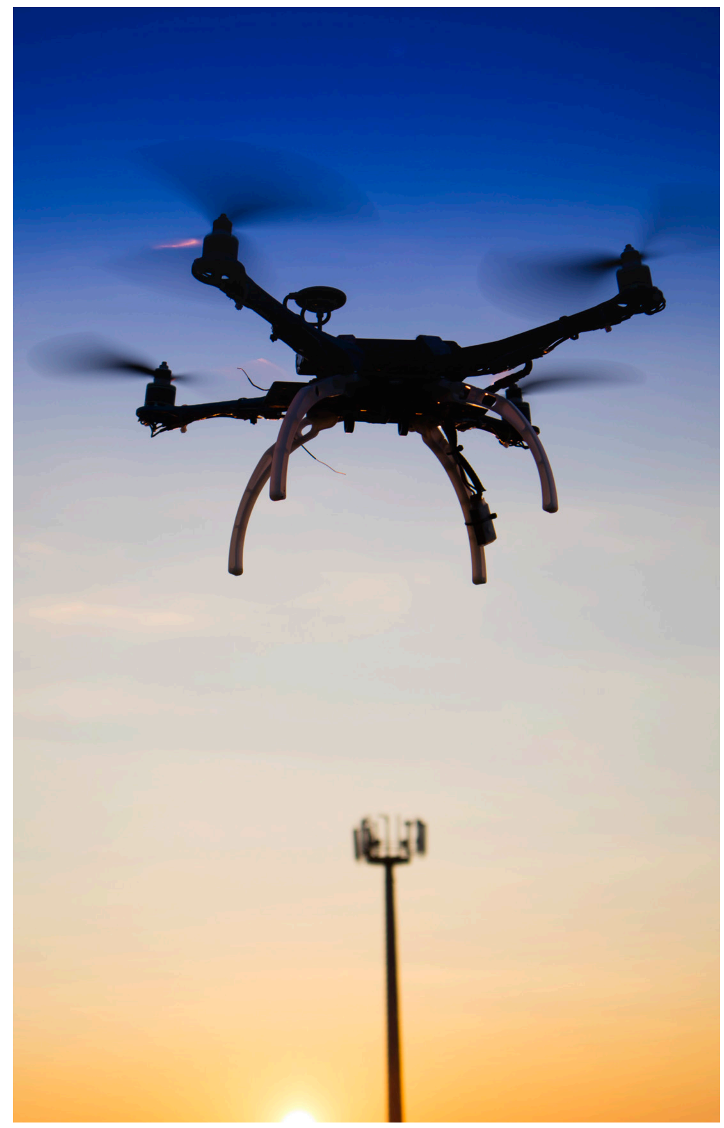
If this book sparked new ideas, we invite you to join us. Back our upcoming Kickstarter campaign and help bring next-generation scanning workflows to more clinics, labs, and care teams around the world.

Stay connected with us at MilestoneDigital.io/SkyMesh3D for behind-the-scenes updates, case studies, new tools, and real-world examples of scanning in action. We're just getting started—and with your support, we can shape the future of personalized medical design together.

With gratitude,
— The SkyMesh 3D Team

SKYMESH 3D

We have a lot more to share about the possibilities of SkyMesh 3D



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SKYMESH 3D

Milestone Digital sets the standard in creating digital assets. Learn more on our website at:

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Lawrenceville, GA

678.696.1195

Delivering high-fidelity 3D data for prosthetics, orthotics, and personalized medical devices. Optimized scan-to-design pipelines for patient comfort, clinical speed, and long-term outcomes. Milestone Digital sets the standard for medical-grade 3D asset creation. Learn more at:

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