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First course in Lviv

3D printing in pedorthics
Experiences and opinions

Official organ of the
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Orthopädie SCHUHTECHNIK

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9. ORTHOPÄDIE SCHUHTECHNIK
on 22nd & 23rd October 2027

ORTHOPÄDIE SCHUH TECHNIK

International Trade Show and Congress

The trade fair of the industry with the largest overview around foot and shoe!

www.ost-messe.de/en/

Staying up to date

A total of 160 companies will be presenting their products and services at ORTHOPÄDIE SCHUH TECHNIK, the international trade fair and congress. This means that the fair will feature more exhibitors than ever before, offering probably the most comprehensive overview of the pedorthic industry to date. Over the last two years, the exhibitors have been working intensively on their innovations. Visitors to the trade fair can therefore look forward to gaining exciting insights into the future development of the industry.

All important information about ORTHOPÄDIE SCHUH TECHNIK – International Trade Fair and Congress, as well as the congress and seminar program, can be found from page 6 onwards in this issue.

Operating conditions for pedorthic companies are not getting any easier worldwide. This makes it all the more important to keep up to date. This is particularly pertinent in times of technological change, as we are currently experiencing. New technologies such as milling and 3D printing are set to replace traditional manufacturing techniques. An increasing number of companies are also turning to external service providers for the use of new technologies or the manufacture of custom orthotic shoes.

In order to overcome current challenges, such as the shortage of skilled workers, new approaches must be adopted in the industry. However, these approaches must be carefully considered. The introduction of new technologies is challenging in itself, as our 3D printing survey shows (p. 16)

All the major suppliers will be present at the trade fair in Cologne, where they will be happy to answer any questions you may have. You will also have the opportunity to meet colleagues and discuss what you have seen with them. This makes trade fairs a unique opportunity to find solutions and new approaches for your business. Whether your business relies primarily on traditional craftsmanship or increasingly uses new technologies, you will find a wide range of offerings in both areas.

Those who have been sceptical of new technologies so far will have the opportunity to take a closer look at them at the trade fair. Many have already recognised that new technologies and manufacturing processes can create new opportunities for smaller businesses, particularly in the context of a shortage of skilled workers. These technologies enable businesses to be productive and successful with fewer, but highly qualified, employees. It is not a business‘s size that is decisive, but its quality and service.
See you in Cologne!

Wolfgang Best
Chief editor

Photo: AdobeStock/Four 888

ORTHOPÄDIE SCHUH TECHNIK 2025 Page 6

With around 160 exhibitors, this year's ORTHOPÄDIE SCHUH TECHNIK trade fair 2025 promises to be the largest and most informative the industry event has ever had. Visitors can look forward to a wide range of exciting topics at the Forum, Congress and Seminars on 24 and 25 October in Cologne.

Photo: Franke/Fischer

Helping Ukraine Page 14

In August 2025, a training project was launched in Ukraine to train skilled workers in pedorthics. The first practical course took place in September.

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Photo frontpage: AdobeStock/Four 888

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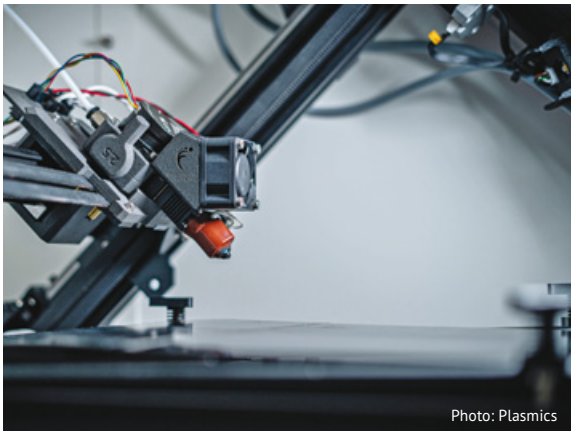

Photo: Plasmics

3D-Printing Page 16

What is the status of 3D printing in pedorthics? We asked podiatrists themselves in a survey.

Imprint

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DEUTSCHE FACHPRESSE

Orthopädie SCHUHTECHNIK

See you in Cologne! Latest infos for trade fair and congress

ANNETTE SWITALA

With around 160 exhibitors, this year's ORTHOPÄDIE SCHUH TECHNIK trade fair 2025 promises to be the largest and most informative the industry event has ever had. Visitors can look forward to a wide range of exciting topics at the Forum, Congress and Seminars on 24 and 25 October in Cologne.

Photo: C. Maurer Fachmedien/Christian Volk

Due to high demand from exhibitors, the organiser C. Maurer Fachmedien, expanded the exhibition space in spring. The additional space was quickly booked up, resulting in the creation of a waiting list.

'We are delighted that both established and emerging companies from Germany and abroad are playing such an active role in presenting the entire industry spectrum to visitors in Cologne, showcasing everything from new products and innovative services to educational offerings and new technologies,' says Carl Otto Maurer, Managing Director of C. Maurer Fachmedien. 'We would also like to thank our gold sponsors, Springer, PLT and Orthofeet, as well as our silver sponsors, Darco, Opta Data and Nimco. They have made a significant contribution to enabling us to organise the event in this way."

There will be a number of new features this year: For the first time, there will be a separate exhibition area for start-ups, where seven young companies will showcase their products and services.

Dedicated area for the FORUM:

The FORUM presentations (see the programme in the box) are open to all trade fair visitors. Here, educational institutions, service providers and industry experts will discuss current topics and innovations. In order to create a quieter, more focused atmosphere, the FORUM has been relocated to the seminar and congress area this year.

Forum presentations will remain free of charge for trade fair visitors. The industry presentations at the FORUM will demonstrate how digitalisation is driving the development of orthopaedic shoe technology through digital manufacturing, 3D printing, new scanning and measurement methods, software developments and artificial intelligence.

There will also be presentations of new developments in the field of education by the providers themselves at the FORUM. The Competence Centre for Orthopaedic Shoe Technology (KomZet O.S.T.), the master schools and Praeparatio e.V. will be providing exciting insights into their projects. (The presentations will mainly be held in German. Unfortunately, no translation will be available.)

CAMPUS with a new dialogue area!

Anyone interested in finding out about educational opportunities in the industry will be in good hands at CAMPUS in the exhibition hall.

CAMPUS in the exhibition hall. Here, master schools, KomZet O.S.T. and the Praeparatio association will be on hand to answer visitors' questions. New this year is a dialogue area, which KomZet O.S.T. and the Study Group for Orthopaedic Shoe Technology will use to deliver interactive content (see the article on page 16).

The editorial and trade fair team from C. Maurer Fachmedien will be welcoming visitors at stand E-032, right next to CAMPUS. Here you will find our specialist literature, including the English edition of the standard work Pedorthics, Bodenbau Schritt für Schritt – so wird ein Schuh draus (Step by Step Footbed Construction – How to Make a Shoe) by Katja Streckhardt and Franz Fischer, the third edition of the reference book Ganganalyse in der Praxis (Gait Analysis in Practice) by Dr Oliver Ludwig, Kompendium Qualitätsstandards

im Bereich Fuß und Schuh (Compendium of Quality Standards in the Field of Feet and Shoes), Grundlagen des Schaftbaus (Fundamentals of Boot Construction) and Von der Trittspur zum Leisten (From Footprint to Last) by Praeparatio e.V., and Füße anatomisch und therapeutisch begreifen (Understanding Feet Anatomically and Therapeutically) by Franz Fischer and Spiraldynamik® expert Dr Jens Wippert. You will also find selected books by our speakers, as well as our trade journals (Orthopädieschuhtechnik, DER FUSS, MTD, Komfortschuhe Spezial and Wie geht's heute), including special issues with special trade fair offers.

Shaping and securing the future of pedorthics

The two-day congress programme comprises 25 presentations and has been organised in collaboration with the German Association for Foot and Ankle Surgery (D.A.F.), the Society for Foot and Ankle Surgery (GFFC), the Study Group for Orthopaedic Shoe Technology and KomZet O.S.T (see page 8).

While the first day will take an interdisciplinary look at foot misalignments, the biomechanics of the foot and shoe, arthrosis therapy and sensorimotor insoles, the second day will focus on the future of orthopaedic shoe technology. How can we secure the future of the pedorthic profession and its expertise in the face of a shortage of skilled workers, technical developments and market changes? Presentations on recruiting young talent, successful training and an industry-specific study, as well as a keynote speech by Wolfgang Best and a panel discussion led by Frédéric Großmann (KomZet OST) with Michael Volkery, Marc-André Villiger, Katja Streckhardt, Andy Paulig and Hartmut Schühle, will encourage everyone who cares about the future of OST to think and discuss.

(At the congress on Friday 24 October, all presentations will be translated into English. Unfortunately, no translation will be available on Saturday).

A total of 25 seminars (see page 9) covering a wide range of topics, from technical and medical content to business management issues and new technologies, will be offered at the 8th ORTHOPÄDIE SCHUH TECHNIK, including special events for apprentices and an English-language seminar. (see box on this page)

Register in good time!

To avoid queuing at the ticket office, it is advisable to book tickets for the trade fair, congress and seminars in advance online. This can easily be done in our ticket shop at www.ost-messe.de/ticketshop.
All further information about the trade fair and congress can be found at www.OST-Messe.de.

Tell me what you want.
What you really, really want!
Understanding User Practices for a Better Design of Assistive Devices

Seminar in English language
Friday, 24 October, 9.30 - 10.30 am

Patients with orthopedic problems often use assistive devices, e.g., ankle-foot orthoses and therapeutic footwear, to support their mobility and improve their quality of life. Assistive devices, such as ankle-foot orthoses and therapeutic footwear are prescribed and designed to improve mobility and to support physical activity, thus contributing in a positive way to the quality of life of their users.

However, to be effective, assistive devices should be used daily. Unfortunately, many users are not satisfied with their devices and use them rarely or do not use them at all. A main cause for this lies in the process of drawing up user requirements. Orthopedic experts seem to have too little insight in the different areas of life of patients leading to deficient design requirements. In this seminar a general approach—the so-called Triple I model—is presented to understand the different areas of life of patients and how they can be included in the design of an assistive device.

The model reflects the perspective of both the craftsman and the patient. It includes the network and stakeholders of both groups, who can make demands and influence decisions when designing assistive devices.

In this interactive seminar we discuss and practice ways to pay more attention to the real needs of the patient and what they want when using their assistive device. This provides the basis for a consistent use and satisfied customers.

Red Holtkamp Photo: Holtkamp

Jessica Hohlenschon Photo: Hohenschon

Congress Program

Friday, 24 October 2025
9.15 am – 10.30 am
Conservative and surgical corrections for axial misalignments of the foot
In cooperation with the Society for Foot and Ankle Surgery (GFFC)

Surgical corrections for ankle misalignments – Prof. Markus Walther
The influence of customized therapeutic shoes on stress on the lower extremities.
A randomized controlled study – Thomas Stief
Pes cavus and flat foot: How can axial misalignments in the rearfoot be corrected? – Dr. Hartmut Stinus
Pedorthic treatment concepts for flat feet – Michael Volkery
Pedorthic treatment concepts for pes cavus – Matthias Löffler

11.00 am – 12.15 pm
Foot and shoe biomechanics
Determining the axis of the lower ankle joint – structure & function – Anja Seeger
The new generation of technical running shoes: Improved performance, increased or reduced risk of injury for recreational runners? – Prof. Gert-Peter Brüggemann

1.30 pm – 2.45 pm
The evolution of arthrosis therapy
In cooperation with the German Association for Foot and Ankle (D.A.F.)
Arthrosis of the forefoot and midfoot: Treatment options and their development – Dr. med. Mona Abbara-Czardybon
Treatment of arthrosis of the lower ankle joint and rearfoot – from back then to now – Dr. med. Benjamin Breuer
Treatment of arthrosis of the ankle joint – Dr. Dariusch Arbab
Biomechanically oriented concepts for the provision of assistive devices for arthrosis of the foot and the ankle joint – Tino Sprekelmeyer/Thomas Stief

3.15 pm – 4:30 pm
Sensomotorics: Science and Practice
In cooperation with the Study Group for Orthopedic Shoe Technology e.V.
Current status of evidence for sensorimotor foot orthotics – Dr. rer. nat. Steven Simon
Enabling movement: The development of sensorimotor foot orthotics – Lothar Jahrling
Sensorimotor foot orthotics (SMFO) vs. proprioceptive foot orthotics – What has developed within 25 years of application? What has remained? – Stephan Woltring
Quality standard in training: Curriculum sensomotorics – Markus Seeßle

Saturday, 25 October 2025
9.15 am – 10.30 am
From practice for practice
Case study: Double-shell orthosis from a 3D printer – OSM Hans-Peter Greifenhagen, OT Fabian Lohmann
International master: Establishing and promoting orthopedic shoe technology abroad – OSM Bernd Franke
The lightness of orthopedics: New approaches and ideas for custom shoe manufacturing – OSM Marc-André Villiger
Consumer REPORT 2025 – Orthopedic shoe technology
Representative market research on consumer behavior, product use and future prospectives – the industry on the move – Jürgen Hanke

11.00 am – 12.15 pm
Recruiting young talent and skilled workers in pedorthics
In cooperation with KomZet Orthopedic Shoe Technology
Next Generation Orthopedic Shoe Technology: How to attract apprentices who stay – Felix Behm
How to train successfully – Clara Böcker, Linus Framme
Recruiting young talent: Are trainee fairs and internships worthwhile – OSM Matthias Ernet
Arousing interest in the profession: Training ambassadors for pedorthics – Luis Blaha, Sascha Wigge, Julia Wedderkopf

1.30 pm – 2.45 pm
The future of pedorthics
Impulse speech:
Do we need a new self-image in our profession? – Wolfgang Best
Challenges and prospects for pedorthics – Panel discussion with representatives from the trade, moderated by Frederic Großmann

Note:
The presentations at the congress will be simultaneously translated into English on Friday, October 24. The seminars will be held in German, with the exception of the seminar by Jessica Hohenschon and Fred Holtkamp on Friday, October 24, from 9:30 to 10:30 a.m.

www.ost-messe.de/en

Seminar Program

Friday, 24 October 2025
9.30 am – 10:30 am
ROOM 1
Understanding feet anatomically and therapeutically – Franz Fischer and Dr. Jens Wippert
ROOM 2
The assessment practice of the Medical Service of German Health Insurances – Dr. med. Aziz Awa
ROOM 3
Tell me what you want. What you really, really want! Understanding User Practices for a Better Design of Assistive Devices
Prof. Fred Holtkamp and Dr. Jessica Hohenschon (Seminar in English language)

2 pm – 3 pm
ROOM 2
Assistive devices: Justify well, prescribe successfully
Dr. Ulrich Hafkemayer and Carsten Kramer

3:30–4:30 p.m.
ROOM 1
Transparent trial shoes from the 3D printer – Martin Jaeger
ROOM 2
Tell me what you want. What you really, really want! Understanding the patient's requirements better: Basis for the design and the actual use of an assistive device
Prof. Fred Holtkamp and Dr. Jessica Hohenschon
ROOM 3
Using external manufacturing in a sensible way
Heike Ziegler and Gerold Elkemann

Saturday, 25 October 2025
9.30 am – 10:30 am
ROOM 1
Spiral dynamics® as a functional approach in therapy – Dr. Jens Wippert
ROOM 2
Scanning in pedorthics
Frederic Großmann and Martin Jaeger
ROOM 3
Current legal issues: External manufacturing and verdict on sensomotorics
Torsten Bornemann

11.00 am – 12.00 am
ROOM 1
From the patient consultation to (better) foot orthotics
Dr. Jens Wippert and Franz Fischer
ROOM 2
Children's feet
Dr. Ludwig Schwering and Dr. Vanni Tim Förster

12.30 pm – 1.30 pm
ROOM 2
The diabetic foot syndrome and the charcot arthropathy
Dr. Ludwig Schwering and Dr. Vanni Tim Förster
ROOM 3
Artificial Intelligence in trade
Patrick Amato

1.30 pm – 3.00 pm
Room 1
2D motion analysis as a tool for optimizing pedorthic treatment
Tino Sprekelmeyer and Thomas Stief

Seminars for Apprentices
Friday, 24 October 2025
11:00 am – 12:00 am
ROOM 1
Introduction to 2D motion analysis
Tino Sprekelmeyer and Thomas Stief
ROOM 2
Sensorimotor treatment with foot orthotics
Dr. Steven Simon

12:30 pm – 1:30 pm
ROOM 1
The diabetic foot syndrome
Leo Lelgemann
ROOM 2
Fields of application and careers in pedorthics
Katja Streckhardt

2:00 pm – 3:00 p.m.
ROOM 1
How to grasp feet anatomically and therapeutically
Franz Fischer and Dr. Jens Wippert
ROOM 3
Introduction to posture – and function analysis
Dr. Oliver Ludwig

Photo: AdobeStock/Four 888

Make the most of the opportunities

From the perspective of suppliers in the industry, how will pedorthics develop in the coming years? To find out, we asked the sponsors of this year's ORTHOPÄDIE SCHUH TECHNIK-trade fair. We asked them to share their outlook on the developments that will influence their market segment, as well as the opportunities available to pedorthic companies within these segments.

PLT – The evolution of pedorthics: digitalization, data, and craftsmanship

Rick Broshuis, Business Development PLT

In recent years, digitalisation has had a significant impact on this field. The use of 3D scanning and digital modelling, as well as the manufacture of lasts using milling techniques and 3D printing, has increased significantly. These technologies allow for more efficient, precise and sustainable work.

Currently, the market is focusing heavily on FDM 3D printing. While we view this as a promising development, it is merely one link in the wider orthopaedic care chain. Companies in the pedorthics sector are currently facing many challenges. Changes in legal requirements and growing documentation obligations with regard to health insurance companies are leading to higher administrative costs. Additionally, there is a risk of valuable expertise being lost as more skilled workers are leaving the profession than entering it, and their knowledge is not being adequately documented. This significantly impacts training and the future of the profession. At the same time, demand for pedorthic care is growing, partly due to the rapid increase in diabetes patients. Companies can address these issues by collaborating to develop high-quality, future-proof pedorthics, where knowledge is systematically documented and shared.

In our opinion, the real progress made through digitalisation lies not only in streamlining production processes, but also in collecting and utilising high-quality data. This makes it possible to automatically model assistive devices on a case-by-case basis. This saves time and leads to more measurable and reproducible results. At the same time, orthopaedic expertise is preserved. A strong focus on knowledge preservation and collaboration in a continuous feedback process enables the further development of the craft, the optimisation of working methods and the training of new specialists on a solid foundation.

In our Stepp Care Network (PLT and Soul2Sole), we treat over 600,000 patients annually. Thanks to our uniform scanning techniques, methods and therapy decisions, as well as our reproducible end products, we are able to provide these patients with systematic and uniform care. This approach enables us to create a 360-degree feedback loop, from measurement to end product. This allows us to secure valuable expertise within the professional field while improving the quality of care. Based on this data, we have also developed a broad product line ranging from 3D-printed foot orthotics and last additions to custom-made shoes.

All innovations developed by Stepp are made available to our European partners. By working together, we are creating sustainable foot care in which the role of the pedorthist is not only preserved but also evolves into that of a diagnostic expert. Together, we are shaping a strong future for the profession.

PLT is Gold-Sponsor of the ORTHOPÄDIE SCHUH TECHNIK
www.steppfootcare.com, www.pltproducts.nl, www.s2s.pt

Springer Aktiv AG – Class meets mass: Between craftsmanship and high-tech: assessing the current situation

Jeannette Arend, Head of Marketing & Medical Affairs Springer Aktiv AG

In our view, pedorthics is at a turning point. The increasing shortage of skilled workers, the rising demand for documentation and efficiency, and the clear cap on expenses imposed by health insurance companies mean that companies must choose between highly specialised, individualised craftsmanship and standardised processes with high throughput rates. Combining both approaches under one roof is becoming a business challenge. At Springer, we are familiar with this tension, both professionally and personally. As a company with a strong focus on sensorimotor foot orthotics, 3D printing technology and digital processes, we are renowned for our customized solutions, which are based on thorough analysis. We are naturally happy to share these success stories because they demonstrate the positive impact of high-quality care on patients' recovery. Often, the improvement in movement is immediately noticeable and visible.

Nevertheless, we have realised that focusing solely on individuality is no longer an economically viable strategy for us as a company, however bitter that may sound. We have noticed that, when it comes to conventional or even low-cost purchasing strategies, Springer is often not the first company that comes to mind in the market. Many buyers do not consider our foot orthotic blanks when selecting their basic or comfort range. While Springer is synonymous with premium quality, this is only part of the truth. Our blank insoles offer what many companies urgent-

ly need today: fast processes, high quality and fair prices across all supply segments.

That's why our message is: Springer offers both class and mass. It's not because we believe both can be equally important in one company in the long term; rather, we want to give our customers the opportunity to decide for themselves. Whatever path you choose, we will provide the right solutions. We are convinced that a differentiated care is the key to the future viability of pedorthics. Machines will soon be able to provide simple standard solutions. The craft's strengths lie in individual analysis, understanding complex treatment requirements and creating appropriate, creative solutions. However, for this to succeed, economic foundations are also needed, and these can come from the right range of blanks.

We are aware that the industry is often viewed with suspicion. This makes it all the more important for us to clarify our role as a supportive partner. We want to strengthen the craft by simplifying processes, imparting knowledge, and helping to save workshop time. Our goal is not to address patients directly and compete with the trade. We supply products that remain deliberately invisible and integrate seamlessly into our partners' care concept. Because no matter which path a company chooses, we can accompany it along the way.

Springer Aktiv AG is Gold-Sponsor of ORTHOPÄDIE SCHUH TECHNIK
www.springer-berlin.de

Orthofeet – Solutions for an active life


Michael Schmitz, VP International Orthofeet

Old in years, but young at heart. This is one way to describe the much-discussed demographic trend in industrialised countries. People over the age of 60 or 70 today do not feel old and want to lead active lives. The most important prerequisite for this is the ability to move around independently. As we age, the consequences of wearing unsuitable footwear for years and limitations in the musculoskeletal system become more apparent. Nevertheless, customers want to remain active and not be slowed down by pain. This also applies to an increasing number of younger people. They are looking for comfortable, supportive shoes for everyday life, whether at work, during sports or in their free time. Anyone who spends a lot of time on their feet knows that only comfortable, supportive shoes ensure a pleasant day. Foot comfort is not a question of age; it is the basis for an active, self-determined life.

This is a great opportunity for shoe retailers offering solutions in this area. The key criteria for success today are a good fit that accommodates the shape of the foot and different widths; soft materials that prevent pressure points; a biomechanically adapted sole with good cushioning properties; and a sporty, fashionable look. Design, which has often taken a back seat to fit and function in comfort shoes in recent years, is becoming increasingly important today. At Orthofeet, we have spent many years developing these criteria, incorporating innovative features such as adjustable support, pressure-free fitting, easy-to-open fastenings, advanced therapeutic materials, the Ortho-Cushion System to enhance walking comfort and the option to fit the shoes with custom insoles.

Originally founded in 1984 to manufacture orthopaedic devices, the American company has spent 25 years offering shoe collections that combine attractive design with innovative comfort features. Orthofeet has also been present in Germany for a year and has already attracted many retailers. The company will be presenting its range at ORTHOPÄDIE SCHUH TECHNIK 2025 in Cologne.

Orthofeet is Gold-Sponsor of ORTHOPÄDIE SCHUH TECHNIK
www.orthofeet.com

DARCO – Mobility is key.


Matthias Hain, Senior Director Marketing, DARCO Europe GmbH

Mobility is crucial to avoiding the need for care and helping people quickly return to their everyday lives, especially after surgery or in cases of chronic illness. This will become increasingly important in the future in order to relieve the burden on the healthcare system. Pedorthics will play an increasingly important role here. It deserves more visibility and appreciation. It's not just the product that's important; the expertise of pedorthists and prosthetists and orthotists in providing and adapting assistive devices is crucial too. As the market leader in therapeutic shoes, we at DARCO see every day how important the right treatment is for maintaining and restoring mobility. Products such as our Movilo® therapeutic comfort shoe and the Relief Dual®, the first flat foot relief shoe to be listed in the German assitive devices directory for ten years, demonstrate how modern solutions can provide concrete assistance. As a silver sponsor of the OST trade fair, we are looking forward to exchanging ideas in Cologne and continuing to collaborate with the industry on our shared mission of helping feet.

DARCO is Silver-Sponsor of ORTHOPÄDIE SCHUH TECHNIK
www.darco.com

NIMCO – Developments in pedorthics

Frans Kruitwagen, Senior Sales Manager, Nimco

Nimco is an international company. How is pedorthics developing in different countries? What problems are common to all countries, and in which areas do they differ?

There are many similarities in the industry worldwide. For years, we have observed an increasing demand for pedorthic services. This is due to an ageing population and an increase in lifestyle diseases. However, there is a shortage of well-trained pedorthic specialists almost everywhere. There is a particular lack of younger specialists, and it is difficult to find new talent because the profession is largely unknown. The existing skilled workers can often no longer meet the demand.

We also see a change in market structures. Smaller businesses are closing, and there is a trend towards larger companies with multiple branches. We also observe an increasing number of financial investors entering the assistive devices market.

Regulations for the provision of assitive devices still vary greatly from country to country. The main differences concern what can be prescribed and how the service is reimbursed. In some cases, assistive devices are paid for in full; in others, co-payments must be made; and in some states, tenders are used.

What are the biggest challenges and opportunities currently facing pedorthics in your opinion?

Companies must adapt to the changed situation and find solutions that enable them to continue treating for their patients. In our view, the focus must shift even more towards consultation and care than towards the actual manufacture of the required assistive device, in order to ensure individualised care. We therefore consider our custom orthotic shoe production service to be a valuable opportunity for smaller companies to maintain their competitiveness and meet market demand.

Some people are still critical of the external production of custom-made shoes, partly because the orthopedic shoemaker can no longer intervene in the production process. In your opinion, what are the most important factors for successful external manufacturing?

The most important thing is good communication. The service provider must be familiar with the customer's wishes and previous working methods, and the customers must know how the service provider works and be prepared to adapt to their working methods. However, it is also crucial that not only the owner wants this, but that the employees also support the concept and are willing to participate.

At the beginning, it takes a little time and perseverance and a willingness to deal with a slightly different production process. When outsourcing production, everything has to be configured precisely in advance so that the finished shoe meets your own expectations. But if you get involved and adapt your own working methods accordingly, you will quickly achieve good results.

Nimco is Silver-Sponsor of ORTHOPÄDIE SCHUH TECHNIK
www.nm4y.com

Opta data – Customized digitization for Pedorthics

Tobias Bender, opta data Ortho Solutions GmbH

At the ORTHOPÄDIE SCHUH TECHNIK Trade Fair, the focus is not only on workpieces, but also on digital tools that can greatly simplify everyday tasks. Industry experts, manufacturers and service providers in the field of pedorthics can learn how digitalisation creates opportunities and improves efficiency.

"The days when a simple customer file was sufficient are over," says Tobias Bender, Managing Director of opta data Ortho Solutions GmbH. "Nowadays, you need an integrated system that combines patient management, communication with health insurance companies and operationale processes."

opta data will present such software at the trade fair. The software was developed by a company formed from the merger of two long-established companies: pead Software GmbH and Michael Martin GmbH & Co. KG. Since July 2025, they have been pooling their expertise under the umbrella of Opta Data Ortho Solutions GmbH, thus becoming part of the Opta Data Group — one of the leading providers of billing, IT and financial services in the healthcare sector. The synergies resulting from this merger are being channelled directly into further developing the PAEDUS software. At OST, the company will present the latest version, which has been developed specifically for orthopaedic companies.

It brings numerous improvements, including an integrated SMS function, AI-based support chat, serial mail dispatch, incognito mode, Girocode invoices, and usage-differentiated user profiles. Of course, all regulatory requirements are taken into account, whether it's the implementation of e-invoicing or the future processing of electronic prescriptions (eVO).

A key issue for the future remains the connection to the telematics infrastructure (TI), which is to be introduced in the assistive devices sector at the beginning of 2026. "Those who opt for TI-enabled solutions early on will gain real planning security," emphasizes Bender. Now is the right time to make the switch, especially for companies that have not yet implemented digital support.

Visitors can find out more about PAEDUS and other solutions at the opta data Group's booth.

opta data is Silver-Sponsor of ORTHOPÄDIE SCHUH TECHNIK
www.paedus.de

Praeparatio: First international shoe upper course

WOLFGANG BEST

The manufacture of uppers for custom orthotic shoes is actually one of the core competencies of a pedorthist. However, this activity is often outsourced to external upper makers, meaning that there are fewer and fewer opportunities to learn this aspect of the profession in companies. The Praeparatio association has closed this gap with an international upper course that took place at the Landshut Training Center, Germany, in August 2025.

The participants of the shaft-making course with their instructors.

For us, the workshop was a trial run," explains association chairman Franz Fischer. "We organized the course together with Austria, Switzerland, and Germany." Isabell Kropf from Switzerland and Peter Weiß, headmaster of the master school for pedorthics in Landshut, were responsible for running the course. It was a diverse group with varying levels of prior knowledge.

To prepare for the course, participants had the opportunity to prepare for the workshop with the help of Praeparatio's new e-learning platform. A total of six tutorials were made available to participants online.

Participants were taught various methods for producing a shaft using a last copy. Isabelle Kropf favors the method of tracing the model onto the last and transferring it to the base model using transparent film—a very practical method for ensuring a good fit. Peter Weiß takes a different approach to last copying. The first step is to create a last copy using paper or film. Using guide lines from the angle-system method, the models can be transferred directly to the basic construction.

In addition to constructing the upper model, participants were also instructed in the use of the machines. The upper leather sewing machine and the sharpening machine were explained in detail before the participants were prepared for practical work on the upper with the help of sewing samples.

A Derby and a U-cut were used as models for practical implementation. The upper model for the U-cut was created on the computer using Corel Draw software to teach the participants the new possibilities in upper construction. The classic Oxford-cut as a full brogue was explained with the help of the book about uppers by Praeparatio. In addition to the sample uppers, each participant also made a pair of uppers for their own last.

The first workshop was only able to cover the basics of upper production. Participants can continue to practice the various models with the help of Praeparatio's e-learning platform. With the help of the book, the various basic models can be detailed and their accuracy checked with the worksheets.

At the end of the workshop, Franz Fischer gave a positive summary: "It was a good workshop, everyone was committed and interested in learning new things." A wide range of possibilities and approaches were covered. And it became clear how important it is to pass on knowledge of shoe upper construction to the next generation in order to secure the existing knowledge in the craft for the future.

The second workshop, "Shaft Construction in Orthopedics," is planned for early 2026. After covering the basics, the workshop will address the difficulty of taking into account the differences in orthopedics between left and right, inside and outside in the basic model and detailing them accordingly. ■

Theory and practice were taught in the shaft-making workshop. Photos: Praeparatio e.V.

Helping Ukraine by training skilled workers

FRANZ FISCHER, BERND FRANKE

In August 2025, a training project was launched in Ukraine to train skilled workers in pedorthics. The aim is to enable them to develop and manufacture customized solutions for foot problems. The first practical course took place in Lviv at the beginning of September.

Russia's war of aggression against Ukraine, which has been ongoing since 2022, has already claimed many lives on both sides. Many soldiers have suffered serious injuries on the front lines and require medical care and often rehabilitation.

For this reason, a rehabilitation center was established in Lviv in 2022, which was inaugurated in the spring of 2023. Part of the rehabilitation center called "Unbroken" is a prosthetic&orthotic as well as a pedorthic workshop, which was built with the help of funding from Germany. Bernd Franke was involved in the planning and setting up of the workshop as part of his work as an international master craftsman.

The workshop in Unbroken was completed at the end of April 2024. Nine workstations for prosthetitists&orthotists and four workstations for pedorthists were created. The workshop was officially opened in May 2024.

Due to a shortage of skilled workers in pedorthics in Ukraine, the German Society for International Cooperation (GIZ) launched a training project in 2025 to train local specialists. The training is intended to enable them to develop and manufacture assistive devices for the foot.

The contract for the training project was awarded to the Praeparatio e.V. association, which was originally founded in 2011 to support journeymen on their way to master craftsman certification in pedorthics with specialist information and training opportunities. In recent years, however, the scope of its activities has expanded. Praeparatio has not only produced specialist books, but also online tutorials to provide specialist knowledge on pedorthics.

The training program aims to provide knowledge about last construction, upper modeling, and the assembly of custom orthotic shoes. The program teaches both classic craft techniques and how to work with digital manufacturing systems, which should help to compensate for the shortage of qualified specialists in the manufacture of assistive devices.

Online training and practical lessons

Since the profession of pedorthics does not exist in Ukraine, there is no specialist literature in Ukrainian. Praeparatio has therefore invested a great deal of effort and commitment in having all previous tutorials based on Praeparatio's specialist books on last and upper construction translated into Ukrainian. This was done in cooperation with the University of Kiev, which has experience in training specialists for the shoe industry. This ensured that all technical terms were translated correctly.

Two prosthesists&orthotists from the workshop in Lviv and two students from the University of Kiev studying shoe design and shoe manufacturing took part in this pilot course.

With the help of Praeparatio's new e-learning platform "Shoeeyeq – E-Learning & Training for Pedorthics," the participants were prepared for the practical part online. They were able to work through all the tutorials in sequence in self-study mode. This was fol-

1 The orthopedic workshop at the rehabilitation center in Lviv was completed in 2024 within a short period of time.

2 Bernd Franke (left) and Franz Fischer in front of the orthopedic workshop, where they taught participants how to make lasts for orthopedic shoes.

lowed by direct, interactive online training with lecturers.

Practical training in the workshop

For the first practical lesson, we traveled to Lviv at the end of August to instruct the four participants of the first pilot course in practical care directly at the "Unbroken" rehabilitation center. Both for the online courses and the practical part, we were supported by an interpreter who had also been involved in translating the texts.

Preparation for the practical lessons in Lviv began on Sunday, August 31, 2025, with a tour of the Unbroken workshop in Lviv.

The workshop started on Monday, September 1, with theory on the topic of taking measurements. The creation of a footprint was discussed and put into practice. A positional drawing of the foot was created in the sagittal and frontal planes.

The feet were molded using various molding methods with plaster and plastic bandages. Digital options using 3D scanning were also used.

The next step was the classic procedure of foaming the impressions and casting the last tip.

The lasts created were shaped using the outline drawing and the last dimensions were adjusted. In the next step, a temporary footbed was created using a thermoforming process. For the test shoe, the technique of thermoforming a film over the last was explained and put into practice.

Once the test shoe with footbed and heel was ready for fitting, all participants tried it on each other. Any discrepancies between the foot and the test shoe were marked so that they could be corrected on the last later. After the correction, the footbeds were sanded to shape for the sole assembly.

The modified last and the working footbed created form the basis for further practical instruction.

At the end of September, Franz Fischer will travel to Lviv for further practical training in upper construction, and in mid-October, Bernd Franke will conclude the practical training for the pilot project with sole construction – the assembly of the shoe. By then, all participants will have completed all the steps necessary for the manufacture of an orthopedic shoe. In the final discussion, the participants were informed about the digital options available for individual work steps. However, it was important for us to first teach the analog work processes in the course, as they form the basis for later use of the digital tools.

Great need for assistive devices

In addition to the practical work, we also had the opportunity to talk to a vocational school in Lviv and the management of the Unbroken clinic. This allowed us to discuss ways in which pedorthics could be established as an independent profession in Ukraine.

During our visit to the Unbroken clinic, we saw many patients with lower leg and thigh amputations. The fact that the clinic has a rehabilitation department covering 10,000 square meters gives an impression of the rehabilitation tasks that have arisen as a result of the war.

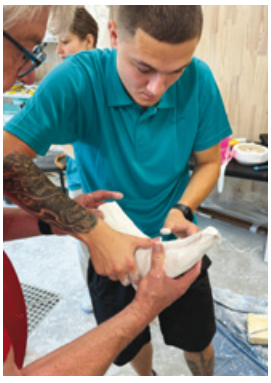
As young orthopedic shoemakers, we still experienced the effects of World War II in our work and even provided custom orthotic shoes to war veterans. We are therefore familiar with such treatments and can pass on our experience in this area.

Unfortunately, there is no end to the war in sight, but the moment will come and it will be a huge task to rebuild the country. This means that people with disabilities will also have to contribute to this effort – and will certainly want to do so.

We have seen many patients who need our help. We would be all the more delighted if we could establish our profession there so that well-trained local specialists could manufacture the necessary assistive devices. ■

Acknowledgement:

The training program would not have been possible without the help of Bernd Franke, who has built up the network over the last few years, Martina Jaeger, who created the tutorials, Martin Jaeger, who prepared the digital topics, and Peter Weiß, who reviews and corrects our materials as an experienced vocational teacher. Not to mention the books by Praeparatio. They were created with the help of many experts and form the basis for the digital learning materials. Not to mention the books by Praeparatio. They were created with the participation of many experts and form the basis for the digital learning programs.




3 – 6 Participants had already learned the theory in advance through online training, so they were able to get straight to work during the course – with Bernd Franke (second image from left) also acting as a test subject. Photos: Franke/Fischer

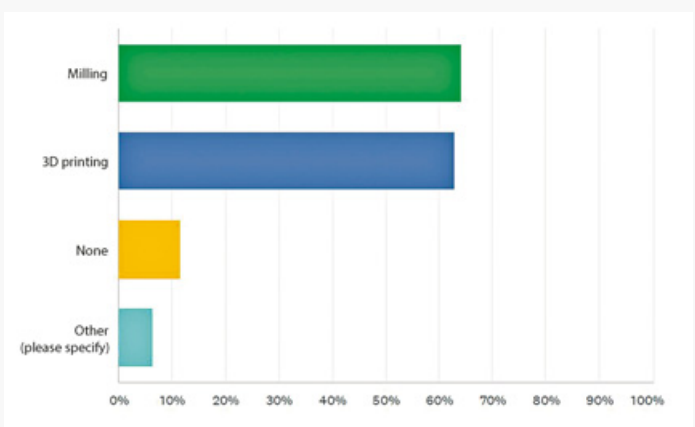
Photo: Sebra/Adobe Stock

3D printing in pedorthics: experiences and opinions

CHRISTINA BAUMGARTNER

3D printing has developed rapidly within the field of pedorthics in recent years. Which printing processes are used by companies? Which assistive devices have crossed the threshold to become fully-fledged production tools, and have they proven themselves in daily practice? The German journal Orthopädieschuhtechnik wanted to find out, so it invited its readers to share their experiences of 3D printing in an online survey. Here are the results.

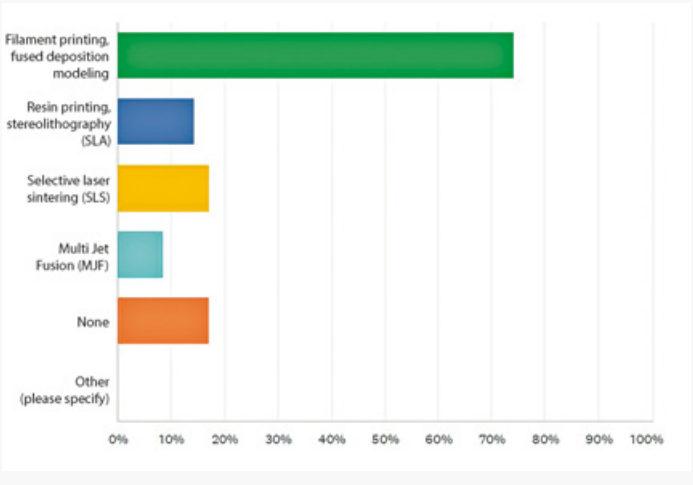
All readers of the German journal "Orthopädieschuhtechnik" who already had experience with digital production—whether printing or milling—were eligible to participate in the online survey. They were asked to answer a total of 15 questions and share their experiences with 3D printing. Among other things, we wanted to know which printing processes they use, which assistive devices or components are already manufactured using 3D printing, and how they assess the future development of this technology. A total of 79 people took part in the survey, mainly business owners or employees/foremen in management positions. The largest participating company had 126 employees, the smallest had two employees, with the median being 9 employees. The survey was mainly completed by companies/individuals who already had experience with 3D printing. It is therefore not possible to make any statements about the prevalence of 3D printing across the entire industry. For a number of questions, it was possible to select multiple answer options.



1 Which computer-aided design and manufacturing processes do you use in your business? (Multiple answers possible)
graphics: C. Maurer Fachmedien

Milling, 3D printing, or both?

64 percent of the pedorthists who participated in the survey mill in their companies, and almost as many (63 percent) use 3D printing – so both technologies are almost neck and neck in our survey (Fig. 1). According to the survey, both processes are used in a number of companies. Twelve percent stated that they do not use either of these processes in their business, while 6 percent use other processes. The majority of survey participants, namely 54 percent, use their own milling machines, while the proportion of those who use a milling service is significantly lower (15 percent). Thirty-two percent stated that they do not mill at all. The situation is similar with 3D printing. The survey shows that here, too, the



2 Which printing process do you use? (Multiple answers possible)

majority of respondents use their own printers (49 percent). In contrast, only 21 percent used a printing service. Thirty-seven percent of respondents do not currently print at all.

Thirty percent are still in the trial phase: they stated that they are currently just trying out 3D printing – 3D printing is not yet used regularly in these companies. In contrast, 51 percent are already more experienced in using 3D printing and are already using it in production.

Which printing methods are used?

The majority of respondents use the FDM (Fused Deposition Modeling) method, also known as filament printing, in which a thermoplastic filament is applied layer by layer (Fig. 2). Almost three-quarters (74 percent) stated that they use this process—its relatively simple handling and manageable costs are likely to contribute to this result.

Second place in our survey went to selective laser sintering (SLS), which is used by 17 percent. This process uses a laser to sinter a powdered raw material to create three-dimensional structures. Close behind is resin printing, also known as stereolithography (SLA): 14 percent said they use this process. This is a 3D printing process that uses a light-curing liquid synthetic resin. Resin printing can be used to create highly detailed objects. Seventeen percent stated that they do not use any of the methods mentioned. A further 9 percent use the Multi Jet Fusion (MJF) printing process, developed by Hewlett Packard (HP).

What assistive devices are being printed?

What assistive devices and components are actually being produced using 3D printing (Fig. 3)? Among the survey participants, these are primarily long-sole foot orthotics (57 percent), lasts (32 percent), and trial shoes (29 percent). Twenty-five percent of respondents also produce 3D-printed orthotics, 20 percent produce foot orthotic components, and 17 percent produce short-sole foot orthotics. One participant also stated that they print shafts, while another is conducting initial trials with forefoot replacements in orthopedic footwear. Seventeen percent stated that they do not print any assistive devices or components at all.

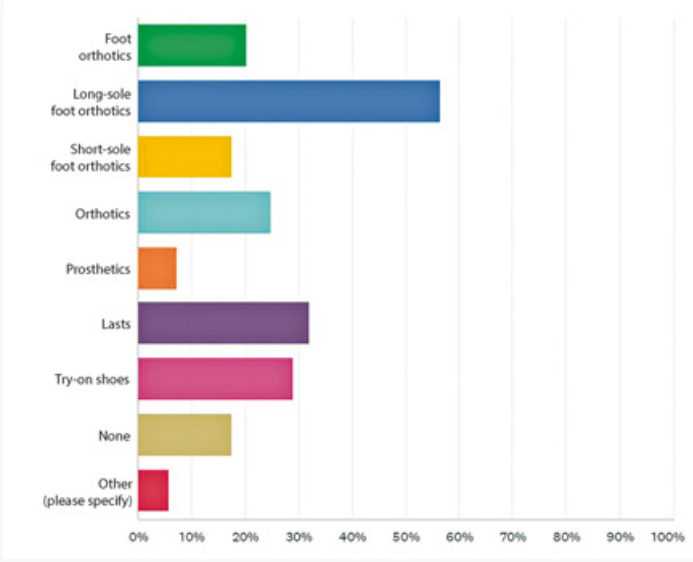
Satisfaction with the quality of manufactured products

Foot orthotics

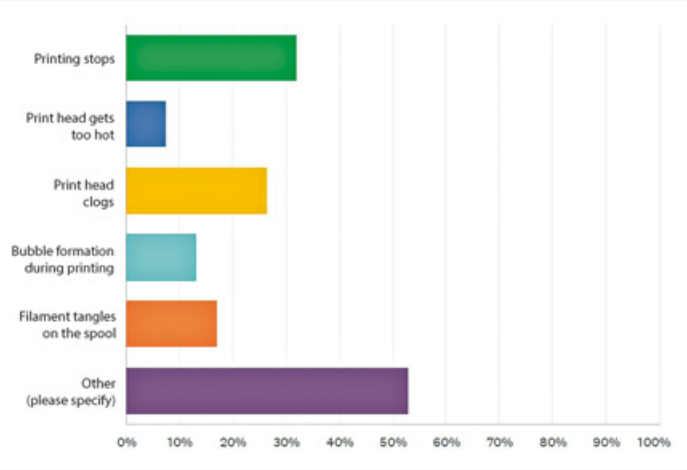
In this context, the question of how the quality of manufactured devices is assessed is also particularly interesting. We asked: How do you rate the quality and properties of printed foot orthotics to date in comparison to individually constructed foot orthotics, individual foot orthotics based on blanks, or milled foot orthotics? Where does 3D printing have advantages, and where are the other processes better?

The good/easy reproducibility was repeatedly mentioned as an advantage in the responses, but the sustainability aspect was also important to many, as was the significantly lower amount of waste compared to milling. A very frequently mentioned disadvantage was the time aspect, as printing takes a long time. Below are some responses and opinions from survey participants:

- "3D printing produces virtually no dust. The fit is significantly better. There is no need to glue anything; the foot orthotic is made from a single piece."
- "3D printing is not yet an alternative to handcrafted foot orthotics."
- "For me, 3D printing has a purely marketing advantage. They (editor's note:



3 Which devices/components do you already manufacture using 3D printing? What do you already print (in-house or externally)?



4 What problems arise in practical operation?

the foot orthotics) cannot be modified. It takes a very long time and is cost-intensive (acquisition costs)."

- "Simple supplies are easy to print, but bedding foot orthotics for relief shoes also work well. Printing saves work in times of skilled labor shortages, but a good milled blank can also have advantages, for example in sports care —in my opinion, printing is not yet ready for this!"
- "The shells are more stable than milled insoles."
- "Advantages: Good reproducibility, good grading options. Disadvantages: Machine running times, construction problems with cushioning and support sections."
- "Just print the rearfoot shell and then continue building it up individually."
- "The downsides are the printing time and the difficulty of making modifications. The biggest advantage is the elimination of the enormous amount of waste involved in milling and the ease of reproducibility."
- "The shape is important—whether printed or not."
- "Advantages of 3D printing: Longer durability, very little to no scrap/waste. Little reworking necessary. Disadvantages: Foot orthotic shapes can only be modified to a limited extent after production. Less choice of materials. 3D printers are significantly more prone to malfunction than milling machines. Long printing times compared to the milling process."
- "Clear advantages lie in reproducibility and material consumption due to less waste. On the other hand, there is significantly higher weight and additional construction costs."
- "For me, it is a very good alternative to milling, as there is no waste."
- "Quality and reproducibility are very good, as is durability. However, 3D-printed insoles are less adaptable and unsuitable for further processing (e.g. bonding different material combinations or adjusting shape and thickness)."
- "3D printing is still in its infancy. It was a mistake to get involved so early."
- "The biggest advantage of our milled foot orthotics the possibility of post-processing."

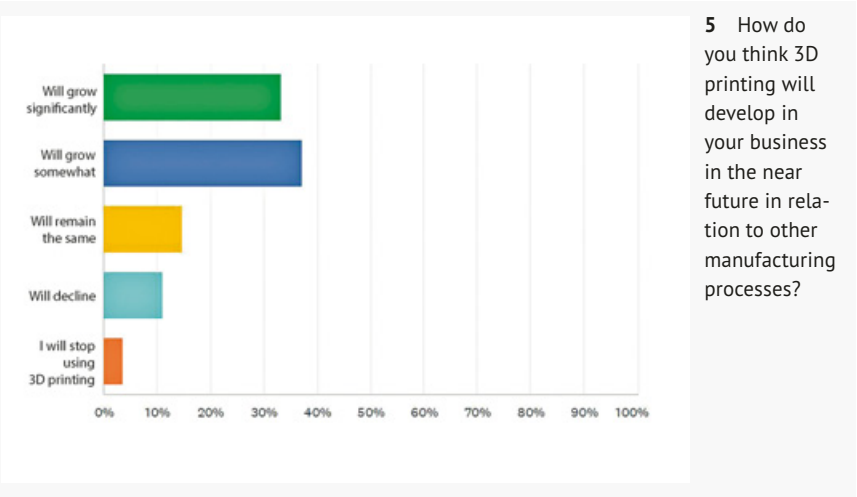
Last

In addition to satisfaction with the quality of 3D-printed foot orthotics, we also wanted to know how the current quality and properties of printed lasts are rated in comparison to foam lasts, milled lasts, or individually sanded and constructed wooden lasts. Several participants also stated that they did not print lasts. The survey participants had the following experiences:

- "3D printing offers many advantages, such as the sequence (first trial shoe, then last). The stability of a wooden last has not yet been fully achieved, but printing is much cheaper."
- "Wooden lasts are better."
- „The quality is okay. The time advantage would only be realized if the digital last could continue to be used by the upper makers. The last could then be printed in-house during the boot manufacturing time. As long as the upper makers only work with analog lasts, there is no advantage to the 3D process. The advantage that the technology must bring us as craftsmen is the time factor in the process between the creation of the last and the finished upper for fitting. This includes software that is understandable and practical for the user (pedorthist/craftsman). Unfortunately, the software we currently use is too complex and error-prone."
- "Very good quality in terms of the resin printing."
- "Lower durability, costs sometimes too high."
- "We still prefer wooden lasts."
- "Milled wooden lasts are easier to sand, work with, and dispose of!"
- "The quality is good, they weigh less, and are more durable than foam lasts, but not as sustainable as wooden lasts."
- "Printed lasts are much more accurate, smoother, and it is faster."
- "Plastic is difficult to rework and cannot be disposed of in the oven."
- "We have currently moved away from printed lasts and back to milled wooden lasts. It is simply easier to make corrections here."
- "Better than foam lasts."
- "Every printing process has its limitations. FDM: brittle, not stable enough; SLA: deforms slightly when exposed to excessive heat; SLS: too heavy. However, the quality of printing processes and materials is constantly improving."
- "In difficult cases, 'plaster' is still used."
- "The quality is good."

What problems are there with 3D printing in practice?

32 percent of participants complain that printing is interrupted during practical operation (Fig. 4). Clogging of the print head also seems to be a frequent problem: 26 percent of respondents had to deal with this issue. Seventeen percent of respondents complain that the filament gets tangled on the spool, 13 per-



5 How do you think 3D printing will develop in your business in the near future in relation to other manufacturing processes?

cent have also noticed blistering during printing, and 8 percent experience the print head becoming too hot. One participant also noted that dimensions from the created last via the slicer are sometimes minimally altered or incorrectly calculated when transferred to the printer, while another noted that printing cushion layers or areas of consistent quality still poses a problem. However, many of the respondents also stated that they had no problems with 3D printing at all or that they were not affected by any potential problems due to contract manufacturing.

Looking to the future

Where is there still room for improvement?

Many survey participants believe that 3D printers and programs need to become significantly cheaper before they will use 3D printing more frequently in their field. The speed at which foot orthotics are printed also needs to improve. "It needs to become easier and more customizable. Printing should take just as long as milling," said one participant. Respondents also wanted more options for making changes and better design software. However, many were already very satisfied and had no suggestions for improvement. Here is a selection of some of the suggestions and opinions:

- "Everything is on the right track. Printing technology is developing rapidly, and with it, speed."
- "Software specifications should be provided so that companies can manage their processes more easily. The cost of a system should be manageable in the offer. In order to be able to decide on a system, it should be possible to try it out on a rental basis."
- "More influence on the foot orthotic shape in the software. Smoother transitions from hard to softer zones. Printing speed should be noticeably increased."
- "CAD tools need to be better."
- "Faster construction and lighter weight. Thinner designs for foot orthotics."
- "Above all, the software needs to be simpler and more intuitive. The materials should also be developed further."
- "SLS printers need to become cheaper."

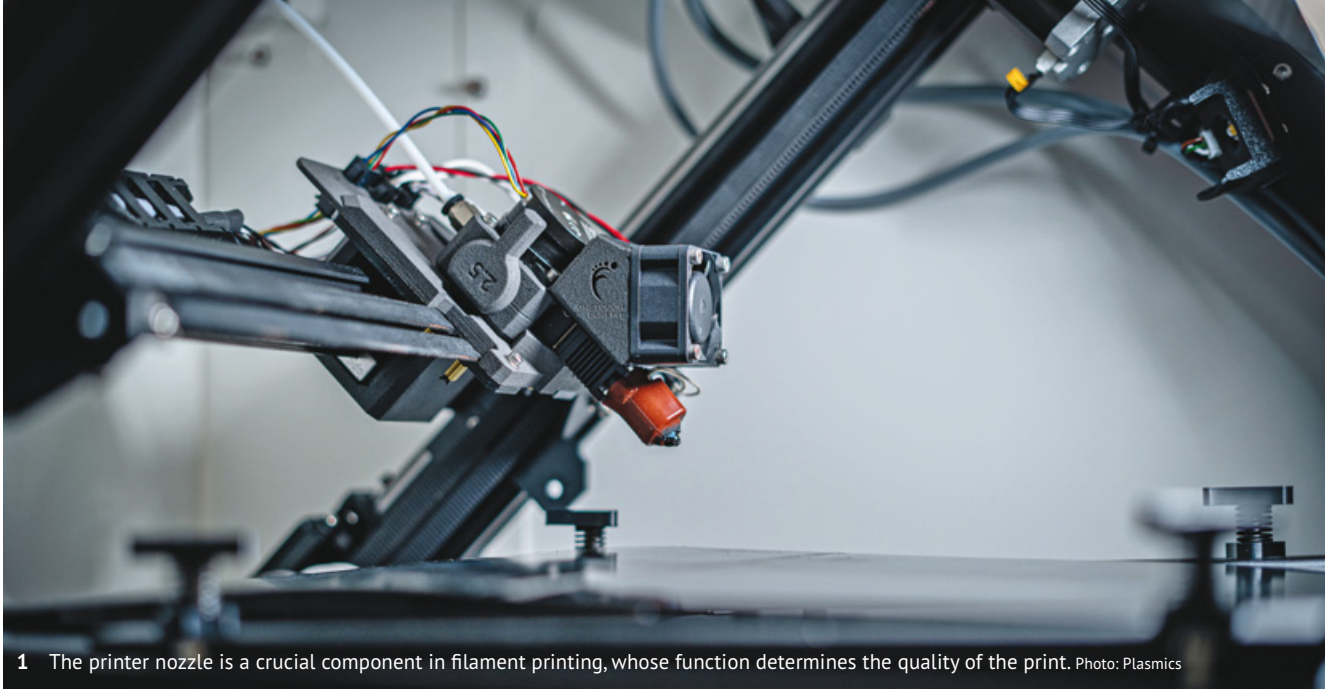
Development of 3D printing in companies

How do you think 3D printing will develop in your company in the near future in relation to other manufacturing processes (Fig. 5)? 33 percent of respondents expect 3D printing to "grow significantly" in their company, while 37 percent said it would "grow somewhat." Fifteen percent expect this area to "remain the same" in their company. Only 11 percent said it would "decrease," and only 4 percent plan to stop using 3D printing altogether. The following reasons, among others, were cited as essential to this assessment:

- "Relief for workers, especially in relation to the shortage of skilled workers."
- "Costs, staff shortages, advantages such as the option of working from home."
- "Young pedorthists are more interested in technology."
- "... will grow if the process is practical for everyone involved and the quality (transparency) of the printed test shoe improves."
- "As long as the quality is not good, not much will change."
- "Customer demands and shortage of skilled workers."
- "More time for other work."
- "Technical development will continue to grow rapidly. Personnel issues will not become less important in the future."
- "Much more flexible treatment options, better and faster treatment, independence through in-house production, fewer staff, and higher price margin".
- "The printing takes too long."
- "The influence on the foot orthotic shape, printing speed, and reliability of the printer will be decisive."
- "Not good enough yet to replace a milling machine."
- "It's a significant image boost for the company, shows customers the advanced technology, and also makes us attractive to young talent."
- "Skills shortage in manufacturing, precision in modeling."
- "Quality, accuracy, individual printing options."
- "Manufacturing with 3D printers requires less personnel."
- "Sustainability and flexibility (e.g., Shore hardness)."

Outlook for the entire industry

The assessment of the development of 3D printing across the entire industry is also rather positive. In relation to milling and traditional foot orthotic production, respondents assess the development as follows: 66 percent assume that 3D printing will increase its share in production compared to other manufacturing processes, 15 percent say that the share will remain roughly the same, and another 15 percent assume that 3D printing will not prevail and its share will decrease. ■



1 The printer nozzle is a crucial component in filament printing, whose function determines the quality of the print. Photo: Plasmics

3D printing: It‘s not just a single technology

WOLFGANG BEST

The first 3D printers were developed over 50 years ago, but it was not until the late 1980s that the three printing technologies that are now the dominant production processes emerged: stereolithography (SLA), also known as resin printing; selective laser sintering (SLS); and fused deposition modeling (FDM), also known as filament printing. This article presents the different technologies and their possible applications in pedorthics.

The concept of 3D printing entered the public consciousness around 15 years ago, when the first filament printers became affordable for private use. This was due to the expiry of the FDM patent. Consequently, additive manufacturing became an accessible prototyping and production technology for businesses, opening up a wide range of new applications.

Recent developments have been so rapid that today, the question of what can be printed is almost unnecessary. Given the predictions for the future of 3D printing, the question is rather, ‘What can’t be printed?’ 3D printing is already widely recognised as a key technology with a constantly expanding range of applications across industries. It is a key driver of innovation in many industrial sectors.

The development of additive manufacturing in various industrial sectors has also benefited the orthopaedic industry, where 3D printing has been a prominent feature at trade fairs for years and has opened up an increasing number of application areas in recent years. Applications range from foot orthotics and orthoses to lasts and trial shoes. Professional solutions are available for many applications and have become an alternative to traditional manufacturing methods. Furthermore, experts point out that 3D printing enables the design of assistive devices that would be prohibitively expensive or impossible to produce using conventional methods. However, there is no single printing technology suitable for all pedorthic requirements. The requirements for the function and material quality of the various devices are too diverse.

Fused deposition modelling (FDM)

FDM, also known as filament printing, is currently the most commonly used printing process in pedorthics. In this 3D printing process, a thermoplastic filament — usually a plastic wire — is applied layer by layer to create a three-dimensional object. The filament is heated in an extruder and extruded through a fine nozzle onto a build platform, or ‘print bed’. The print head then moves across the work surface, applying the molten material layer by layer according to the digital model. Each layer hardens quickly after application, allowing the next layer to be built on top of it. The diameter of the nozzle determines the width of the extruded plastic strand. The process always starts with a CAD design of the object, which must first be prepared so that the printer can be controlled correctly. This involves breaking down the 3D model into many horizontal layers using slicing software. This software then generates machine code that specifies the printer’s movements and settings.

In most printers, the filament is wound onto a spool and transported to the print head, where it is heated. However, some printers now use pellets instead, in a process similar to injection moulding. These pellets are stored in a hopper above the nozzle and fall downwards. A rotating screw then conveys the granulate from the hopper to the nozzle. Integrated heating elements then melt the granulate ready for printing.

To save material and time, larger objects, such as shoe lasts, are usually only printed solidly on the outside, with a lightweight support structure provided inside. Depending on the object, it may be necessary to print support structures to prevent it from tipping over or collapsing during printing. Various types of plastic can be used for printing, ranging from soft to hard. Today, there are printers that can process materials of different strengths in a single step. However, some manufacturers deliberately choose to print with only one material, meeting different stability, strength, flexibility and cushioning requirements through the design of the printed structures, which can be made soft or hard. This means that the printed foot orthotics can later be completely recycled and the material used for new insoles. Many FDM printers have a print bed from which the finished insoles must be removed. Increasingly, printers with a conveyor belt are also being offered to transport the finished foot orthotics, allowing another pair to be printed. This enables continuous production, not only during working hours, but also overnight. Given the often relatively long printing times, this is an important factor for many users. However, this requires the process to run stably over a long period of time. There are many influencing factors here that must be controlled by the user to prevent printing from stopping. Currently, FDM printing is mainly used in pedorthics for foot orthotics, footbeds and trial shoes.

Selective laser sintering

Selective laser sintering (SLS) is a 3D printing technology that uses a laser to fuse layers of powdered material together to create a final product. The powder can consist of various materials, such as nylon, TPEs and TPUs, depending on the desired end product. During the printing process, the powder is spread in a thin layer on a platform inside the build chamber. The printer then heats the powder to a temperature slightly below the melting point of the raw material. The laser then traces the predefined shape on the print bed, mechanically welding and solidifying the particles. After each layer has melted, a roller passes over the bed to spread the next layer of powder. This process is repeated until the component is complete. Selective laser sintering is primarily used for manufacturing durable plastic parts, such as those previously produced by injection moulding. In pedorthics, it is mainly used to manufacture lasts and foot orthotics, such as full-sole, thin and lightweight orthotics, or firm heel cups for conventional orthotic production.

Stereolithography (SLA)/resin printing:

Stereolithography (SLA), a UV laser beam is focused onto a thin layer of liquid photopolymer resin, tracing the shape defined in CAD. The light-sensitive resin then hardens, forming a 2D layer of the object. More layers of resin are then applied and exposed until the three-dimensional object is complete. The layers that are exposed can be very thin, enabling the printing of fine structures. To print complex components, support structures must also be printed, which are then removed during post-processing. After printing, the components must be chemically cleaned with acetone or isopropanol and cured in a UV cabinet to achieve the desired material properties. In pedorthics, this process is used for manufacturing shoe lasts and printing foot orthotic shells, among other things. Due to the material's high load-bearing capacity, resin printing is also used to manufacture orthoses and face masks to protect athletes after nasal bone fractures, for example. ■

2 SLS printing is widely used in the industry. It can be used to manufacture a wide variety of products and workpieces. Photo: Formlabs

3 In SLA printing (resin printing), the print object is exposed layer by layer. Depending on the design, support structures are also printed. Photo: Formlabs

Photo: Maridav/Adobe Stock

Motion analysis: Measurement without markers

WOLFGANG BEST

Markerless motion analysis systems promise valid measurement data on human movement without the hassle of having to stick markers onto the body. AI-based systems still have a lot to learn before they can reach the level of the current gold standard. However, expectations for their future performance are high—also in terms of the new possibilities offered by their simpler application.

When it came to measuring joint angles as accurately as possible, there was previously no alternative to marker-based analysis. Three-dimensional gait analysis using this technique is based on light-reflecting marker balls that are attached to specific anatomical landmarks. The markers are detected by several infrared cameras distributed throughout the room, allowing their position in space to be determined precisely during movement.

However, this "gold standard" in motion analysis is usually limited to large laboratories in clinics or colleges and universities. The reason: the acquisition costs are too high for many potential users, and the effort required for an analysis, which involves attaching numerous markers to the test person, is not feasible in everyday life for many due to time and cost reasons.

Marker-based systems have also been and continue to be available in the form of simpler, two-dimensional video analysis – at significantly lower costs. However, here too, the effort involved in attaching the markers usually prevents routine use.

This is exactly where markerless analysis comes in, promising less effort: accurate movement data with joint angle measurement without the need to equip the test subject or patient with markers.

Provided that the data collected is accurate enough, this opens up completely new possibilities for motion analysis in many areas of healthcare where the evaluation of movement is important for therapy planning and monitoring. Numerous possible applications are also being discussed and already used in competitive sports.

Systems must be trained

But how do markerless systems recognize joints and anatomical points in order to measure joint movements and angles? They have to learn it.

Markerless motion analysis is made possible by a combination of modern technologies. AI-supported image recognition can analyze videos or individual images recorded with standard cameras (e.g., tablets, smartphones, webcams).

Image processing technologies extract silhouettes or 3D models from the recordings, thus enabling the analysis of motion sequences, joint angles, and postures. Deep learning algorithms and neural networks play a central role. These must be trained with large, appropriately labeled image datasets so that their algorithms can automatically recognize body parts and determine the positions of relevant joints and body segments in the image or video. Markerless motion analysis systems combine the various technologies, enabling virtually automated motion analysis. The data obtained is analyzed and evaluated by the software in order to objectively assess, for example, gait patterns, joint functionality, or misalignments.

The basic systems for this type of analysis are usually freely available. However, how well the markerless system can recognize and measure movements depends not only on the technology used. "It depends on what you do with it," says Benjamin Homilius of Contemplas, which has been offering a markerless analysis system since 2021. "The quality of the analysis depends on how well the system is trained and on what." Markerless sys-

tems are initially dumb and do not know that a person is walking in front of the camera. The system must first be taught this, as well as where the points important for analysis are located. And that actually still involves a lot of manual work, marking the corresponding landmarks on the body during the recordings – until the system is able to recognize these points itself in the recordings. According to Homilius, this initially took several months. And what applies to humans also applies to these motion analysis systems: you never stop learning. To further improve the analysis or expand the analysis spectrum, the systems are continuously fed with data and trained.

As with marker-based systems, there are also two-dimensional and three-dimensional versions of markerless analyses. While two cameras, one for the frontal plane and one for the sagittal plane, are sufficient for 2D analysis, the use of additional cameras is recommended for the most accurate three-dimensional analysis possible. However, there are already providers who promise to calculate three-dimensional data from the images captured by a mobile phone camera.

Accuracy depends on the region of the body being examined

How accurate are markerless systems? This question naturally arises when AI that has been trained with data is suddenly expected to independently recognize and capture anatomical points in motion. Are the joints and their pivot points recognized correctly?

This question has already been investigated in numerous scientific studies. A review (Scataglini et al. 2024) summarized some of these studies in which markerless systems were tested and evaluated their results in terms of accuracy.

Overall, the review paints a positive picture of markerless systems. The spatiotemporal parameters showed good accuracy, validity, and reliability overall. For the kinematic variables, there was moderate to excellent agreement between the systems at the hip and knee, while poor concurrent validity and reliability were measured for the ankle joint.

Furthermore, kinematic parameters for the hip and knee in the sagittal plane are considered to be the most valid and reliable. In general, however, poor correlations and higher errors were measured in the transverse plane for all joints. Hip rotations also appear to be still a problem for markerless systems.

The review mentioned above also criticized the fact that many of the studies had a small number of subjects, which could lead to inaccurate results. In addition, they were mostly conducted with young, healthy subjects, which does not correspond to the planned applications in a clinical setting. There is also no clear consensus yet on the accuracy, validity, and reliability of markerless systems in gait analysis. Before a markerless gait analysis system can be fully introduced into clinical practice, further research—and probably further training of the systems—with patients with gait pathologies is necessary.

High expectations for the new technology

Despite the current shortcomings, the review mentioned above believes that markerless systems will eventually be able to overcome some of the weaknesses of marker-based systems. No matter how precisely the markers are placed, the skin on which they are attached moves when walking or running and no longer represents the exact anatomical point on the skeleton that was intended to be marked. The hope is that markerless systems will eventually be able to record joint movements more accurately because they are less susceptible to inaccuracies caused by marker movements or shifts.

Markerless motion analysis systems have sparked the imagination in many areas, raising expectations about the insights that can be gained in the future with simplified yet accurate analysis. One example is competitive sports, where as much data as possible has long been collected and evaluated, including with AI systems. In the future, AI will also be used to perform motion analyses in order to optimize movement sequences or predict the likelihood of injuries, for example. Thanks to advanced data analysis and machine learning methods, athletes will be able to individualize their techniques and training plans in order to achieve maximum performance. To this end, data from different systems will be merged.

Physiotherapy also has high hopes for AI-supported movement analysis. This makes it easy to record a patient's range of motion and functional abilities, for example, and track them over the course of therapy. By analyzing movement data together with other relevant information, it should also be possible to create personalized treatment plans that increase the effectiveness of therapy. Last but not least, automated motion detection should also enable patients to complete their exercises at home using appropriate devices. Based on the recorded movement, the system should provide direct feedback on whether the exercise was performed correctly.

Proving the effectiveness of assistive devices becomes easier

Markerless systems can also open up new applications for motion analysis in pedorthics. If no major preparation is required and the system is already set up, it is easier to use it to validate observations of gait or running style, or to check the effect of a treatment. Above all, however, a simple analysis that still provides valid data on gait could make a significant contribution to justifying treatments to health insurance companies – especially in cases where there is currently no reimbursement available. ■

Literature:

Scataglini, S.; Abts, E.; Van Bocxlaer, C.; Van den Bussche, M.; Meletani, S.; Truijen, S.: Accuracy, Validity, and Reliability of Markerless Camera-Based 3D Motion Capture Systems versus Marker-Based 3D Motion Capture Systems in Gait Analysis: A Systematic Review and Meta-Analysis. Sensors 2024, 24, 3686. https://doi.org/10.3390/s24113686

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6.5 Creating a negative plaster mold

More than 80% of custom-made orthotic footwear is created in this or a similar way (Fig. 6–8).

An essential basic task for the pedorthist is creating an exact negative plaster mold of the foot. Prerequisite to this is a correct, manual examination of the active and passive musculoskeletal system of the lower extremities (see Chapter 22). This provides information about the optimal position of the foot in the shoe. Ideally, the patient will have already been treated by a physiotherapist so that an optimal range of motion can be used when creating the mold.

The mobility of the ankle is tested based on the corrected hindfoot, the position of which is paramount to treatment (Fig. 1 a – d). The calcaneal tuberosity is maximally corrected for a non-contracted valgus hindfoot. An equinus foot deformity is tolerated. The procedure is similar for a clubfoot: maximum hindfoot correction, plantigrade adjustment of the ankle. To achieve a consistent left-right result in the plaster mold, the deformed foot is plastered first and then the healthier foot is adjusted.

Preparations:
1. Welcome.
2. Medical history.
3. Findings.
4. Foot as non-edematous as possible.
5. Optimal patient positioning (on a chair, in bed, on a seat shell, on mother's lap, ...).
6. Explain and define treatment goals.

Material (Fig. 7):
1. Original/planned footwear (socks, compression stocking, bandage...).
2. Plaster area.
3. Plaster bandages (4 cm x 12cm).
4. Insulating foil.
5. Scalpel, knife.
6. Cutting mat.
7. Container with water.
8. Latex gloves, sized appropriately.
9. Block for the heel pitch.

Procedure (Fig. 7, 8):
1. Wrap foot with foil from distal to proximal in the intended direction of correction: On the one hand, the edema is pressed
2. Fix the
3. Put on
4. Hold p
squeez
5. Wrap p
foot ar
reache
6. Spread
7. Adapt
8. Foot c
forefo

Fig. 7 Set up the plaster working area.

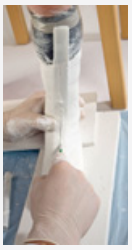
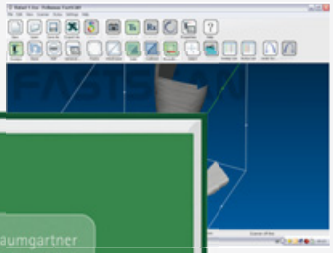
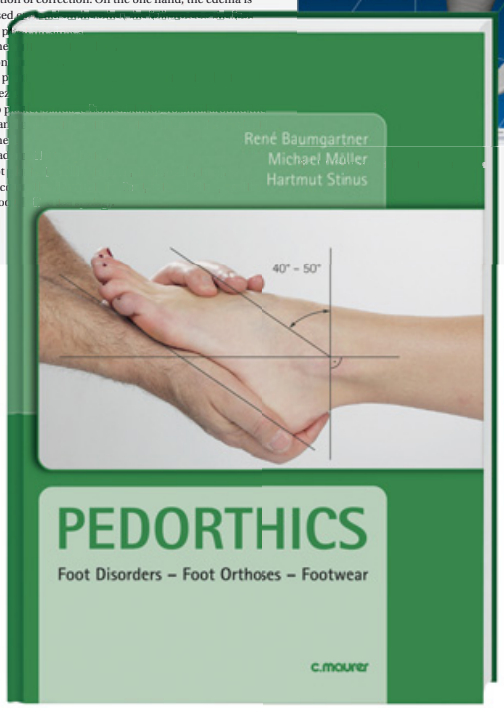


Fig. 8 Cut open plaster on the cutting mat with scalpel.

Fig. 9 Finished plaster negative.





9. Allow the plaster to harden.
10. Cut open with the knife.
11. Carefully pull off the negative mold.
12. Close with a strip of plaster.
13. Remove foil and clean area.
14. Make the next appointment and explain the further procedure before seeing the patient out.

6.6 3D foot scan

3D scan technology is becoming more and more important (Fig. 10 – 12). A distinction is made between:

A Scanning in the box: The patient is put into a position where the foot can be scanned from every side. The surface of the skin is registered. Corrections are not possible for patients requiring custom orthotics. It is easier to treat patients when the frontal median is not important and a template is available from the shoe last archive or the digital last library.

B Hand scanners have the advantage that they can be used around the patient, allowing the patient to maintain a more relaxed posture. Good corrections, however, are not always possible with these (Fig. 11, 12). Newer and smaller scanners are available from the company Gebiom, among others.

6.7 Plaster negative and scan technology

One way to take advantage of the positive correction capabilities of the plaster cast and the advantages of scanning is to combine these two methods. A plaster cast is first made as described above, and subsequently scanned. For this method, it is also possible to use a last from the shoe last archive. The virtually generated raw lasts can also be modeled on the computer with the aid of suitable software, and then milled.

6.8 Foot foam and scan technology

With special software, the data from different scans can be combined and assembled into a virtual object. In this way, the foot-sole mold can be scanned from the corrected foot foam and then mirrored (Fig. 13, 14). The dorsal portion of the foot and lower leg is scanned directly on the patient. The object to be scanned should move as little as possible. Subsequently, the two virtual halves are joined to form the complete foot. The changeover from manual work to virtual computer modeling is particularly challenging in this case.

Fig. 11 Scanner (manufacturer: Gebiom).

Fig. 12 Scanning a positive shoe last (manufacturer: Spenle).

Fig. 13 Scanning the foot in the foot foam.

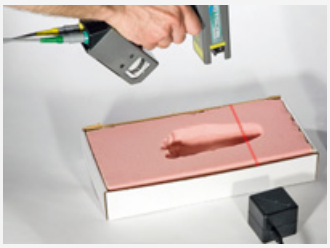


Fig. 14 Scanning the corrected foot foam.