

CASE REPORT*J Forensic Sci*, 2016

doi: 10.1111/1556-4029.13037

Available online at: onlinelibrary.wiley.com

JURISPRUDENCE; GENERAL*Michael Nirenberg,¹ D.P.M.***Meeting a Forensic Podiatry Admissibility Challenge: A *Daubert* Case Study**

ABSTRACT: This article is an introduction to the United States Supreme Court's standard of admissibility of forensic evidence and testimony at trial, known as the *Daubert* standard, with emphasis on how this standard applies to the field of forensic podiatry. The author, a forensic podiatrist, provided law enforcement with evidence tying a bloody sock-clad footprint found at the scene of a homicide to the suspect. In 2014, the author testified at a pretrial hearing, known as "a *Daubert* hearing," to address the admissibility of this evidence in court. This was the first instance of forensic podiatry being the primary subject of a *Daubert* hearing. The hearing resulted in the court ordering this evidence admissible. The expert's testimony contributed to the suspect's conviction. This article serves as a reference for forensic podiatrists and experts in similar fields that involve impression evidence, providing evidentiary standards and their impact on expert evidence and testimony.

KEYWORDS: forensic science, forensic podiatry, expert testimony, *Daubert*, *Frye*, *Kumho*, *Joiner*, Federal Rules of Evidence, law, footprint, expert witness

The impetus for writing this article arises from a personal experience as a forensic expert in a criminal prosecution, *State of Wisconsin versus Travis L. Petersen*. The author conducted a forensic podiatry analysis and submitted a report showing commonality between the defendant's footprint and a bloody footprint found at a crime scene. The testimony provided involved the forensic podiatry evaluation of the defendant in which the author had investigators obtain photographs of the defendant's feet and inked footprints from the defendant. This was accomplished by having the defendant stand and walk on long rolls of paper with his feet barefoot and then again wearing socks.

The crime scene footprints were a mix of partial footprints, distorted or smeared footprints, and overlapping footprints. The author evaluated each footprint, often using digital enhancement techniques to improve clarity, and chose the footprint that was most clear to be used for the comparison process with the defendant's footprints.

In forensic podiatry, footprint comparison should employ at least two methods whenever possible. Recommended is a combination (1), applying both the overlay method and the linear measurement method. The author utilized a combination in the *Petersen* case.

The overlay method compares morphological features. These features include the position, shape, and contour of the toes; the anterior edge of the ball of the foot (the web ridge line); the arch, heel and pressure points; the overall shape of the footprint; and other characteristics. In the overlay method, the suspect's footprint is copied onto a clear acetate sheet and laid over the crime scene footprint for comparison. In addition, morphology

comparison may employ outlines, "cut outs," and digital methods of comparison.

The linear method measures the distance between anatomical reference points or landmarks on a footprint and compares these measurements with the same reference points taken from another footprint. In this case, the author compared 11 measurements on the crime scene footprint with the defendant's footprint. He found that each linear measurement had a difference of significantly less than a recognized error margin of ± 5 mm (1).

The author utilized all of the methods mentioned above in this case, in addition to applying digital measurements of the footprints and creating digital "to scale" overlays of the defendant's footprint over the crime scene footprint.

The forensic podiatrist performing footprint comparisons should also consider, when applicable, other features, such as crease lines, skin lesions, pathology, other anomalies, as well as functional aspects, such as lack of heel strike or inversion of the foot, and also the absence of expected features. For example, in the *Petersen* case in which the author testified, the fifth toe impression was absent from both the crime scene footprint and the defendant's footprint. Consideration was given as to the podiatric causative factors for this variation.

Importantly, throughout the footprint comparison process, the forensic podiatrist should look for any morphological features, functional aspects, measured distances, or other anomalies that would preclude the suspect's foot from the ability to make the crime scene footprint. In *Petersen*, no such findings were found.

The author found commonality between the defendant Petersen's footprint and the crime scene footprint. He submitted a "Footprint Evidence" report to the Waushara County Sheriff's Department, a copy of which was forwarded to the Waushara County District Attorney. The suspect's defense counsel received a copy of the report and requested a hearing to challenge the admissibility of the report and the author's testimony at trial.

¹Friendly Foot Care, PC, 50 West 94th Place, Crown Point, IN.

Received 17 Feb. 2015; and in revised form 5 July 2015; accepted 5 July 2015.

The author found that in this experience—as a podiatrist and as a forensic expert witness—there is still a wide knowledge gap between the world of podiatry and that of the law. This article will attempt to bridge this gap for podiatrists who may find themselves on the witness stand as forensic experts.

Forensic podiatry is a subspecialty of podiatric medicine, defined as "... the application of sound and researched podiatry knowledge and experience in forensic investigations, to show the association of an individual with a scene of crime scene of a crime, or to answer any other legal question concerned with the foot or footwear that requires knowledge of the functioning foot" (2). Although forensic podiatry encompasses several foot-related areas, such as footwear and gait analysis, the focus of this article was on foot impression evidence and the podiatrist's role in providing forensic testimony in a criminal prosecution.

Footprint evidence has a long history, dating back to a documented case involving a bloody footprint that helped result in a murder conviction in 1862 (3). However, podiatrists regularly serving as forensic experts is a relatively recent development. In the 1970s, podiatrist Dr. Norman Gunn began assisting law enforcement in the analysis of footprint evidence and provided court testimony. Since that time, a few other podiatrists have played a notable role in criminal proceedings associated with foot-related evidence (4,5).

The need for foot impression evidence and the demand for podiatrists to provide forensic testimony are both on the rise, and it appears that interest in this area is continuing to grow. Today within the United States, the American Society of Forensic Podiatry has 51 members. Further, the area of forensic podiatry is the subject of study at the New York College of Podiatric Medicine, a postgraduate degree at University of Huddersfield in the U.K., and a scientific publication, including a textbook (1). In addition, the specialty is recognized by forensic organizations throughout the world. To practice forensically, a podiatrist must gain competence in applying principles of podiatric medicine in a forensic context (6). The usual manner in which to attain this competency is through additional training and education, as well as hands-on research.

Given this growth in the role of podiatry as a forensic tool, it is important to understand that all such expert testimony provided at trial must adhere to the specific procedural and evidentiary rules of the court governing expert witnesses. As such, forensic podiatrists who provide analysis of evidence in criminal proceedings in the United States should have some background in the basic legal standards for the admission of forensic evidence and expert testimony in state and federal court.

Legal Precedent on Expert Testimony

Forensic testimony can provide a great deal of insight to a jury deciding a criminal case. However, because juries often do not possess the technical expertise to evaluate testimony objectively, partisan expert witnesses presenting pseudo-science or "junk science" have the potential to mislead them. As will be discussed below, the admissibility standards applied by courts to admit beneficial expert testimony, while filtering out unqualified testimony has continued to evolve over time.

The Frye Test

The longest standing legal standard used to determine the admissibility of an expert's scientific testimony was established in 1923 in *Frye v. United States* (7). In *Frye*, the Court of

Appeals for the District of Columbia Circuit weighed the as to whether the trial court's refusal to admit the systolic blood pressure test—a forerunner of the polygraph test—was proper. In doing so, the Court established a guideline for admissibility of scientific expert testimony. The ruling stated: "... the thing from which the deduction is made must be sufficiently established to have gained general acceptance in the particular field in which it belongs" (7). This decision came to be known as the "Frye standard" and was cited as authority in federal and state courts for some time. Essentially, if the expert's theories and methods had "gained general acceptance" in the relevant scientific community, then the testimony was admissible. With more recent Supreme Court decisions, the *Frye* standard has been updated by a new standard. Federal courts now apply a more contemporary standard established in *Daubert v. Merrell Dow Pharmaceuticals, Inc* (8).

The Daubert Test

The *Daubert* standard is the test currently used in the federal courts and some state courts, replacing the *Frye* standard, which had been in effect for more than 90 years. The Supreme Court in *Daubert* held that the trial judge must initially decide, pursuant to Federal Rule of Evidence (FRE) 104(a), if the expert is "proposing to testify to (i) scientific knowledge that (ii) will assist the trier of fact to understand or determine a fact in issue." *Daubert* held that the Supreme Court's interpretation of Federal Rules of Evidence and specifically Rule 702 displaced *Frye*'s "general acceptance" test, making the Federal Rules the controlling standard in federal court. The *Daubert* Court said that trial judges are the "gatekeepers" of what scientific or technical testimony is admissible in court, and for testimony to be admissible:

- The trial judge must find that the expert's testimony is relevant to helping the ruling body (i.e., jury or judge) determine the facts of the case.
- The trial judge must determine that it is more likely than not that the expert's methods are reliable and were reliably applied in the particular case. On this issue, the Court stated "In a case involving scientific evidence, *evidentiary reliability* will be based upon *scientific validity*" (emphasis in original) (8). With regard to tests of reliability of an expert's opinion, the Court stated: "the expert's opinion will have a reliable basis in the knowledge and experience of his discipline" (8).
- The trial judge must find that the scientific testimony proffered by an expert comes from scientific knowledge. On this point, the Court advised that for expert testimony to come from scientific knowledge, the trial judge must find that it is from the scientific method or "scientific methodology." The Court explained that scientific methodology is "based on generating hypotheses and testing them to see if they can be falsified; indeed, this methodology is what distinguishes science from other fields of human inquiry" (8–11).

Daubert Factors

The Supreme Court provided a list of factors, commonly referred to as "*Daubert* factors," that trial judges must consider when determining whether evidence derives from scientific knowledge (8–11). The factors may be summarized in the following questions:

- Can the technique, science, or theory be tested, and has it been tested?
- Has the technique, science, or theory been subject to peer review and publication?
- What is the known or potential rate of error?
- Is there the existence and maintenance of standards for the control of the science or technique's operation?
- Has the science or technique been generally accepted within the relevant scientific community?

The Supreme Court in *Daubert* emphasized that admissibility of the expert's testimony should rest only on an examination of the expert's "principles and methodology," and "not on the conclusions that they generate" (8). The *Daubert* Court addressed the issue of scientific certainty, stating, "... it would be unreasonable to conclude that the subject of scientific testimony must be known to a certainty; arguably, there are no certainties in science" (8). The Supreme Court further explained that scientific testimony "must be supported by appropriate validation—i.e. good grounds, based on what is known" (8).

Justice Blackmun and the majority envisioned *Daubert* as encouraging debate of expert testimony in an effort to root out evidence not based on science, stating, "Vigorous cross examination, presentation of contrary evidence, and careful instruction on the burden of proof are the traditional and appropriate means of attacking shaky but admissible evidence" (7,12).

"General acceptance, Blackmun wrote, is not a necessary precondition to the admissibility of scientific evidence under the Federal Rules of Evidence..." However, Rule 702 requires that the trial judge ensure that an expert's testimony "both rests on a reliable foundation and is relevant to the task at hand." The *Daubert* Court went on to conclude that pertinent evidence "based on scientifically valid principles" is sufficient to satisfy those demands (8).

Clarifying *Daubert*

Since the *Daubert* ruling in 1993, a number of Supreme Court decisions have refined the legal doctrine on the admissibility of expert testimony. The so called "*Daubert* Trilogy" of cases represents *Daubert* and subsequent distinctions and explanations made in *General Electric Co. v. Joiner* (13) and *Kumho Tire v. Carmichael* (14).

In *Joiner*, the U.S. Supreme Court provided clarity on the *Daubert* standard. Here, the experts' testimony was ruled inadmissible because they failed to respond, presumably in language the court could understand, to objections from the defense. Chief Justice Rehnquist, in his majority opinion, held that a Court of Appeals applying an "abuse-of-discretion" review to expert witness admissibility rulings "may not categorically distinguish between rulings allowing expert testimony and rulings disallowing it." Here, the Court of Appeals applied an overly "stringent" review to that ruling, and it "failed to give the trial court the deference that is the hallmark of abuse-of-discretion review" (13).

The Supreme Court boiled down the *Joiner* case to the issue of whether the experts' opinions were sufficiently supported by the studies on which they purported to rely. However, the studies in question were so dissimilar to the facts presented in the case that it was held not to be an abuse of discretion for the District Court to reject the experts' reliance on them (13).

Attorney Anthony Roisman writes: "... the practical result of this decision will be the presentation of extensive explanations, in lay language, of how and why certain data supports the

conclusions of the experts" (15). *Joiner* emphasized the need to respond thoroughly to criticisms and questions from opposing counsel, given the propensity for judicial scrutiny of outside expert testimony.

In *Kumho*, the Supreme Court ruled that the trial judge's gate-keeping function applies not only to scientific testimony, but also to all expert testimony (including nonscientific) (14).

The *Kumho* Court also emphasized *Daubert's* flexibility, stating, "...the test of reliability is 'flexible', and *Daubert's* list of specific factors neither necessarily nor exclusively applies to all experts or in every case. Rather the law grants a district court the same broad latitude when it decides how to determine the reliability as it enjoys in respect to its ultimate reliability determination" (14).

Further, *Kumho* held that, as a part of the trial judge's gate-keeper function, it may examine the role of professional experience—something forensic podiatrists who are also practicing podiatrists may bring to their forensic analysis. In the Opinion of the Court, Justice Breyer wrote, "... The expert's opinion will have a reliable basis in the knowledge and experience of his discipline... The objective of that requirement is to ensure the reliability of and relevancy of expert testimony. It is to make certain that an expert, whether basing testimony upon professional studies or personal experience, employs in the courtroom the same level of intellectual rigor that characterizes the practice of an expert in the relevant field" (14,16).

Beyond the *Daubert* Trilogy, which the forensic podiatrist is encouraged to thoroughly review, he or she should be aware of other rulings and scientific findings that may have an impact on their expert testimony. In 2002, in *U.S. v. Mooney*, the First Circuit Court of Appeals observed, "*Daubert* does not require that the party who proffers expert testimony carry the burden of proving to the judge that the expert's assessment of the situation is correct... It demands only that the proponent of the evidence show that the expert's conclusion has been arrived at in a scientifically sound and methodologically reliable fashion". With this quote from *Ruiz-Troche v. Pepsi Cola of P.R. Bottling Co.*, the First Circuit found that the expert's testimony and his ultimate opinion were "inevitably linked because they were based on the same methodology" (17). In addition, the First Circuit noted that Rule 702 "specifically allows qualified experts to offer their opinions, a testimonial latitude generally unavailable to other witnesses" (17). The *Mooney* Court went on to say that "once a trial judge determines the reliability of the proffered expert's methodology and the validity of his reasoning, the expert should be permitted to testify as to the inferences and conclusions he draws from it, and any flaws in his opinion may be exposed through cross-examination or competing expert testimony." Indeed, this rationale has played out any number of times in federal district courts where a party objects to the admissibility of an expert witness, and the judge permits his or her testimony with the reminder to the objecting party that cross-examination is the vehicle for probing the veracity of the expert's statements (16).

In 2005, the *Joiner* ruling was applied by the Seventh Circuit in *Zenith Electronics v. WH-TV Broadcasting*, where the expert witness was asked about his methods to generate projections (18). The expert merely responded "my expertise," conceding that he did not use a reliable methodology. As a result, the Court of Appeals ruled that the expert was using "expert intuition" and the testimony was ruled to be inadmissible (18). Quoting *Joiner*, the Seventh Circuit went on to say that "experts commonly extrapolate from existing data. But nothing in either *Daubert* or

the Federal Rules of Evidence requires a district court to admit opinion evidence which is connected to existing data only by the ipse dixit of the expert" (18).

That same year, the U.S. Congress directed the National Academy of Sciences to study forensic science, which led to the publication in 2009 of the report "Strengthening Forensic Science in the United States: A Path Forward" (NAS) (19). The NAS did not directly address forensic podiatry, but its findings are worthy of study by forensic podiatrists, as they give direction on forensic testimony, including recommendations on error rates, veracity, probabilities, and terminology with respect to individualization determinations—the principles of which relate to forensic podiatry.

Federal Rules of Evidence

Besides case law that provides guidelines for the scope of testimonial evidence, in 1975 the U.S. Congress passed the Federal Rules of Evidence (FRE), which governs federal courts and includes rules on expert witness admissibility.

The Notes of Advisory Committee on the Proposed Rules in 1972 explained that the rule "recognizes that an expert on the stand may give a dissertation or exposition of scientific or other principles relevant to the case, leaving the trier of fact to apply them to the facts" (21). The use of opinions will still be permissible, the Advisory Committee stated, "for the experts to take the further step of suggesting the inference which should be drawn from applying the specialized knowledge to the facts" (21). In fact, several Circuits have incorporated this dissertation language from the Notes of Advisory Committee on the Proposed Rules in 1972 into opinions focusing on the extent of expert testimony (22). The 1972 Notes interpret the meaning of the Rule, insofar as "the expert is viewed, not in a narrow sense, but as a person qualified by 'knowledge, skill, experience, training or education'." With this annotation, the scope of the rule was expanded beyond "only experts in the strictest sense of the word... but also [to] the large group sometimes called 'skilled' witnesses, such as bankers or landowners testifying to land values" (21).

In 2000, these evidentiary rules were revised in response to *Daubert*, and the published notes by the federal advisory committee that accompanied the revision provide further clarification to Rule 702 on expert witness testimony. The advisory committee's notes are illustrative and help clarify Rule 702. For example, if the expert is relying primarily on experience, then he or she "must explain how that experience leads to the conclusion reached, why that experience is a sufficient basis for the opinion, and how that experience is reliably applied to the facts." The Committee remarked that "[a] review of the caselaw after *Daubert* shows that the rejection of expert testimony is the exception rather than the rule" (20). (Emphasis added by author.) It is important to note that for cases being heard in state court, each jurisdiction will apply its specific state rules of evidence, the majority of which used the federal rules as a guide.

Additional updates to Rule 702 in 2000 included other aspects of *Daubert* and *Kumho*. A witness who is qualified as an expert by knowledge, skill, experience, training, or education may testify in the form of an opinion or otherwise if:

- the expert's scientific, technical, or other specialized knowledge will help the trier of fact to understand the evidence or to determine a fact in issue;
- the testimony is based on sufficient facts or data;

- the testimony is the product of reliable principles and methods; and
- the expert has reliably applied the principles and methods to the facts of the case (20).

Rule 702 was again amended in 2011 as part of the restyling of the Evidence Rules to make them easier to understand and to add greater consistency. The rules are updated occasionally, and forensic experts providing testimony in federal courts should review the most current update, including any committee notes or commentary (21).

As a further caveat, given that a vast majority of litigation in the United States occurs in state courts, it is more likely that an expert witness will testify in state court rather than in federal. It is important to understand that state courts and federal courts are bound by their own specific procedural and evidentiary rules and case law precedents. However, one should not feel as if learning the nuances of the varying legal doctrines governing expert testimony in the state and federal system should be a prerequisite to presenting expert testimony. Rather, simply understanding that the general principles contained in *Frye* and the *Daubert* progeny cases largely dictate how an expert witness will be treated in most U.S. courts. There may be slight differences around the edges, but the core principles outlined above will hold true.

Preparing for a *Daubert* Hearing

From the *Daubert* Trilogy and related cases, the forensic podiatrist participating in a *Daubert* or *Daubert*-type hearing should recognize that *Daubert* factors are guidelines. They are flexible, and depending on the circumstances of the case and the testimony offered, not every factor may need to be met or met completely. Further, if a forensic podiatrist is challenged on the reliability of the scientific principles he or she has employed, it does not necessarily mean the testimony fails to meet the *Daubert* standard (8).

An additional aspect of a *Daubert* hearing often involves the determination of whether the expert is qualified to testify. The trial judge will base this decision on a review of the expert's knowledge, skill, experience, education, and/or training. Thus, the forensic podiatrist must be prepared to explain how forensic podiatry, in the context of the case in question, meets the *Daubert* standard, and why he or she is qualified to testify.

The American legal system is adversarial in nature using scrutiny of facts in the form of cross-examination as a method of testing the veracity of factual claims. In that light, opposing counsel will likely attack the forensic podiatrist's opinions on these issues with the goal of proving to the court that the expert's testimony is unreliable or of limited probative value, and ultimately should not be admitted.

The latitude for the opposing counsel's questions in a *Daubert* hearing is broad and often extends beyond simply asking about the qualifications of the forensic podiatrist, the science of forensic podiatry, and the methods employed in the case. Because forensic podiatry is not as well known as other forensic sciences, such as fingerprint or DNA evidence, the forensic podiatrist should be prepared to field questions on the definition, history, and origins of the specialty.

As discussed above, forensic testimony rarely proceeds to trial without some scrutiny from opposing counsel or the court. The NAS found that "lawyers and judges often have insufficient training and background in scientific methodology, and they

often fail to fully comprehend the approaches employed by different forensic science disciplines and the reliability of forensic science evidence that is offered in trial” (19). Given the technical nature of forensic podiatry, the forensic podiatrist serving as an expert often becomes an in-court educator, providing not only conclusions, but also educating all parties involved. Accordingly, forensic podiatrists must be prepared to respond to questions involving techniques employed or conclusions reached. It is important these experts respond in a manner that appropriately emphasizes scientific reliability and validity of the underlying science. Where the underlying science emerges in part from other aspects of forensic science, the forensic podiatrist should be prepared to explain how these aspects of forensic science provide scientific rigor to his or her conclusions. Further, forensic podiatrists should be prepared to explain the relevance of their education, training, and practical experience to the expert testimony provided. This includes validation studies, quality assurance issues, such as peer review and verification of the conclusions, and alternative explanations considered during the forensic analysis.

Daubert and Rule 702 are the parameters for the admission of expert testimony in federal courts, and more than half of the states have adopted *Daubert* or deem the *Daubert* standard consistent with its state law. Nonetheless, the *Frye* standard remains law in some jurisdictions (23). Each state has its own specific admissibility standards for expert witness evidence and testimony. These standards often follow *Daubert*, *Frye*, the Federal Rules of Evidence, or some combination thereof. Although the basic concepts determining when scientific evidence meets the standard for admissibility in court are similar for most of the United States, forensic podiatrists should understand the specific nuances of the particular state or jurisdiction in which they are testifying.

Case Study

This is a summary of the relevant facts of a *Daubert* hearing to exclude the admissibility of the author providing forensic podiatry expert testimony in the matter of *State of Wisconsin v. Travis L. Petersen* (24).

Fifty-year-old Robert Kasun was found murdered in his motel room in Waushara County, Wisconsin in March 2013. Kasun had a fractured skull, broken ribs, and a severed aorta. On the floor in Kasun’s room, near his body, investigators identified blood. Upon chemical enhancement with luminol, the blood revealed footprints on the floor. Police arrested Travis Petersen, 42, who was staying in the motel in the room next to Kasun and charged him with first-degree intentional homicide.

Investigators asked the author, who is a practicing podiatrist and a forensic podiatrist, to determine whether Petersen could have made (or not made) the bloody footprints, or whether the evidence was inconclusive. The author conducted a forensic podiatry analysis and submitted a report showing commonality between Petersen’s foot and the bloody footprint.

Defense counsel requested a *Daubert* hearing to exclude the admissibility of the author’s report and his testimony at trial. The state of Wisconsin adopted the *Daubert* standard in 2011 when its legislature amended Wisconsin Statute § 907.02 (25).

The structure of the *Daubert* hearing was similar to that of a trial. As the author was an expert witness for the State, the State questioned him first, followed by a cross-examination from the defense, followed by redirect by the State. Each side then presented a closing argument. The judge subsequently rules on the issue, either directly from the bench at the close of the hearing

or at a later date. Parties may also be asked to submit briefs to the judge to assist in the decision.

Prior to the *Daubert* hearing, the author provided the court (and defense) with peer-reviewed journal articles and material from forensic textbooks related to forensic podiatry and footprint evidence (23,26–39). (Forensic podiatrists delivering this content should have a thorough knowledge of the materials they supply to the court. The author suggests that the materials be easily recalled from memory. For example, regarding one of the articles on a study of bare footprints, the author had to explain how the study’s sample population was obtained.)

The questioning during the hearing was not a verbatim recitation of the *Daubert* factors, but was, nonetheless, in line with the overall *Daubert* standard. Some points of interest are included within this case study, as the transcript of the hearing runs over 100 pages.

The *Daubert* hearing was held on December 4, 2014, and as the case at hand concerned footprints, the questioning focused on forensic podiatry as it relates to footprint analysis.

Initially, the State questioned the author, inquiring about podiatry and forensic podiatry in general, including questions about forensic podiatry’s definition, scope, and history. Prosecutors also asked about the author’s background, experience, and training with regard to podiatry and forensic podiatry.

The State’s questions then addressed forensic podiatry in general and about the specifics of this case. The subjects included forensic podiatry principles (and the research that underlies those principles); the specialty’s general acceptance; whether forensic podiatry has been subject to peer review; the methodology of forensic podiatry and the methods employed in this case (including the linear measurement method and the overlay method of footprint analysis, and how the forensic principles of class and individual characteristics relate to footprints); and the potential error rate and reliability in footprint analysis.

Cross-examination from the defense focused on the principles and methodology of forensic podiatry in general and with regard to the case in question, rather than the history of forensic podiatry, its definition, or the author’s training and credentials. The lack of questioning about the author’s training and credentials is unusual. Forensic podiatrists should be prepared for cross-examination on this issue, as case law frequently shows objections to an expert’s qualifications as a first salvo in the defense’s attack. In the *Petersen* case, the author’s training and credentials were provided to defense counsel prior to the hearing, and perhaps, the defense was satisfied with the author’s competence in forensic podiatry.

The defense asked about the process of analyzing footprints and about whether a footprint left at a crime scene was of sufficient quality to have evidentiary value. This line of questioning led to specific inquiries regarding a sock-clad footprint—as opposed to a bare footprint—as the bloody footprint in this case was sock-clad. The defense argued that the existing research concerning footprints predominantly involved bare footprints (not sock-clad), and as a result, forensic podiatry testimony should be inadmissible. Central to the sock-clad argument was the defense’s effort to establish differences between a sock-clad footprint and bare footprint. Counsel asked the author, “Is it your belief or is it your opinion that a bare foot would make a different impression than a foot covered with a sock?”

Unlike a deposition, where witnesses may strive to answer questions by providing the minimal information necessary and no additional facts, in a *Daubert* hearing, the expert is arguing for the judge to allow him or her to testify. As such, it is critical

that the expert clarifies answers that could mislead the judge. Regarding the question asked above by the defense, the simplest correct answer would have been “Yes.” However, that answer by itself would not allow the judge to appreciate the finer aspects of sock-clad and bare footprints that are the same, such as morphology. With added detail and granularity, the author explained how sock-clad and bare footprint impressions are different and how they are similar.

The question about bare feet and socked feet gave the author the opportunity to emphasize the strength of the State’s case by explaining that linking a sock-clad footprint at the crime scene to the suspect’s sock-clad footprint increased the chance for variation between the footprints because the type of socks that the criminal wore at the crime scene was not known. Socks were provided for the suspect to wear during the creation of his footprints. The author explained to the Court:

... the interesting thing is that the police are guessing at or they are doing an educated guess in some cases on what kind of sock to put on the suspect when they do the bare-foot impressions; so there is a higher likelihood of difference when you are dealing with a sock footprint to sock footprint. And when you have a degree of matching... that is in some ways stronger, because we do not know with certainty what kind of sock he was wearing when he made his footprint (40).

On redirect examination on this “sock-clad versus bare footprint” issue, the State used a similar technique of providing the judge with additional relevant information within its question, while cuing the witness to discuss this information. Directing the author to recall a chapter on foot impression evidence that he submitted to the Court prior to the *Daubert* hearing from the textbook *Footwear Impression Evidence: Detection, Recovery and Examination, Second Edition*, (39) the State said:

On page 389 of that [textbook], there is some suggestion that, quote, The study also noted that the foot leads (sic) a two-dimensional impression that is repeatedly consistent in its size, shape, contour, and proportional features which can be used to distinguish one foot from another. This is also true for sock-clad impressions, which leave an impression very similar to the bare foot... (41).

Also on redirect, the State questioned the author on the findings of other scientific research that he supplied to the Court that addressed what the State termed as the “morphological reliability” of sock-clad footprints. In discussing this research, the author quoted a text in his answer, stating that, “The article by Smerecki and Lovejoy says... ‘... footprints made through socks or stockings can leave an anatomical morphology that can be examined to yield a high degree of identification’ “ (42).

The defense also questioned the author regarding the overlay method and linear measurement method. As to the linear measurement method, the defense suggested that the determination of reference points on the footprints used for measurements was not scientific. The defense questioned the author extensively on this matter.

During the State’s closing argument, the State commented on the science of forensic podiatry, stating:

You are not talking about a theoretical science here. You are not talking about amorphous theory or a fact pattern that involves PTSD, or psychology, or the nature of addictions. In this case, what you are dealing with is what I would call the classical hard sciences, if you will, or very close to them.

You are dealing with something like a print. It is tangible, okay? You can see it. You can photograph it. You can trace it. You can luminol it. You can replicate it to scale, and then you can measure it to scale. You can measure its width, its length, its depth—and this is—and then apply math, just simple math. You can split it into hemispheres... and then measure it from static points in various fields (43).

The thrust of the defense’s closing argument was that forensic podiatry is not science and does not meet the *Daubert* standard. In addition, the defense counsel stated:

I find it odd that we, “we” being the defense, weren’t able to find any scholarly articles or any experts who refute this information that Dr. Nirenberg has presented. And the fact that we haven’t found any doesn’t mean that the Court can’t rule in our favor, because what it tells me Judge, is that this is a field that’s still emerging and hasn’t been fully vetted as a reliable scientific field... Let’s use fingerprint and tool mark, for example. Those are the most comparable scientific fields because those two, along with this forensic podiatry field, all involve identifying crime-scene evidence to the suspect. And those fields have been fully vetted. And there is a lot of criticism in those fields, and that criticism continues. And how forensic podiatry has sort of escaped being fully vetted is beyond me (44).

This argument by the defense appears to be, in part, an attempt to show forensic podiatry, in general, has not met the *Daubert* factor of having been subject to peer review and publication. As the U.S. Supreme Court in *Daubert* explained, “... submission to the scrutiny of the scientific community is a component of ‘good science’, in part because it increases the likelihood that substantive flaws in the methodology will be detected” (8).

Providing scientific literature on forensic podiatry and footprint evidence to the court by the author prior to the *Daubert* hearing served to weaken this argument. Additionally, on this issue one could argue that forensic podiatry has not been subject to the extent of criticism as other forensic sciences because the techniques and methodologies are reliable and scientific (i.e., the methodology does not have “substantive flaws”). More importantly, forensic podiatrists themselves have vetted the specialty to such an extent by rooting out and providing “criticism” of unreliable aspects. For example, Vernon et al. have shown that shoe outsole patterns are unstable and caution must be used when analyzing them (45,46). This study also found that prior research (47–50) purporting that foot pathologies create characteristic outsole wear patterns on footwear was incorrect (45,51).

The defense was also critical of the research by the FBI on footprint impression evidence that the author and State referenced during the *Daubert* hearing. Employing a “guilt by association” argument, the defense recalled the FBI’s erroneous fingerprint analysis in the Madrid train bombing of 2004 that led to the false arrest of Portland attorney Brandon Mayfield. They

held that just because research is conducted or published by the FBI “doesn’t make this evidence any more or less reliable when analyzing it under a *Daubert* prism” (52).

Given recent revelations regarding flawed hair fiber analysis by the FBI, forensic podiatrists, and other experts who reference FBI research in their case work or at a *Daubert* hearing should expect the defense to subject the research to similar or more vigorous criticism (53).

The judge’s opinion on his ruling in the *Daubert* hearing stated the following about forensic podiatry evidence in general:

I do recognize that we are working through what is not necessarily a novel area, but one with which we have a collective degree of ignorance among the counsel that are participating, in this case. I know I’ve never seen a situation involving the use of forensic podiatry... I believe it’s probable that the reason for that is that you don’t very often have a footprint, barefoot or sock-clad, left at the scene of a crime the same way that you would expect fingerprints to come into the picture. We don’t touch things with our feet the way we do with our hands. It’s a simple, common, understood way about how humans interact with one another and their environment (54).

With regard to the *Daubert* “relevancy” issue, the judge opined:

When the Court is addressing a challenge of this nature, I, first of all, must determine whether or not the evidence is relevant. I find it highly relevant in this instance. It matters, in this case... It places an identification of a latent footprint left at the scene of a crime. And any information tending to assign ownership to that footprint is, by definition, relevant and will be immensely helpful to the trier of fact in determining the identity, if you will, of the perpetrator of the offense... (55).

On the subject of reliability, the judge noted:

The Court next has to address the reliability of the information that is being evaluated, and that’s where much of the criticism has been offered here. Recognizing this is not an area that has been subjected to the same degree of peer scrutiny, perhaps, as other areas of forensic science, we, nonetheless, in the Court’s judgment, have substantial reliability that’s been established. The series of articles that were produced in advance of the hearing and which were referred to during the course of Dr. Nirenberg’s testimony provide a great deal of guidance in that regard... all of which I’ve read, indicative of the process through which this method of identification has evolved and the scientific principles that are applied to it (56).

The judge addressed the defense’s primary argument that forensic podiatry is not science:

Attorney Nielsen [for the defense] makes a novel, certainly interesting argument that this really isn’t science. We don’t need a podiatrist. I find that, as I’ve indicated, to be an intelligent argument, although curious in that the foundation of the science that is applied, as testified by Dr. Nirenberg and as indicated in the series of treatises cited, is the inner relationship highly complex between the foot, the ankle,

the 22 [sic] bones that compose that region of the lower extremity, and the biomechanical relationship that they have to other motions within the human body, the transfer of weight, the manner in which certain types of impressions demonstrative of body caricature are reflected in a footprint, hardly the type of principle to which a layperson would have the degree of knowledge and understanding to derive meaningful interpretation... (57).

A significant part of the defense’s argument was that the research using bare footprints was not applicable because the bloody footprint was made from a sock-clad foot, not a bare foot. The judge addressed this contention:

The third tier of this analysis is whether or not Dr. Nirenberg’s application of the reliable science... is meeting the threshold of reliability... I came into this case concerned about the relationship between what it appeared to the Court were a majority of studies regarding the scientific reliability of podiatric analysis, and the fact those studies had been conducted upon bare feet, and that it was known to me... that the latent footprint in this case was made by a foot that had been clad with a sock.

I believe the issue is very clearly addressed to the Court’s satisfaction, first of all, by the two Treatises which directly address it... both of which indicate the relationship and direct nexus between studies that have been done on bare feet and podiatric analysis and the studies that have been done on feet that have been in socks.

And then after Dr. Nirenberg explained the similarity to me and why that nexus can be directly drawn, I understood it much better... The foot leaves specific impressions when the owner of the foot walks upon it, does so in a manner, which, essentially, if not nullifying, greatly mitigate the necessity of having any of the types of skin surface to imprint surface transition normally affiliated with a fingerprint, which, from a lay perspective, had troubled me to a certain extent. And it’s very clearly understood to this Court now why it is that the relationship between the science applied in a barefoot podiatric analysis translates without any type of interruption to a circumstance where the foot leaving the impression was clad with a sock (52).

The judge addressed the concept of the expert accounting for alternative explanations in part stating:

Critical also, in the Court’s judgment, there were at least three or four times in his testimony where Dr. Nirenberg indicated what he is really trying to do, more than finding similarities between the latent print and exemplar, is to find distinguishing features to try and eliminate, rather than include. I derived a very clear understanding from his analytical approach that the thrust of what he is trying to do is to find something that doesn’t match, to find something inconsistent or that excludes (58).

The judge concluded the *Daubert* hearing by ruling that the author could provide forensic podiatry testimony, stating, “Dr.

Nirenberg may testify that the latent print found at the scene of this crime matched the exemplar provided by Mr. Petersen; and it is for the trier of fact to determine the degree of weight to be given to that opinion" (59).

On January 6, 2015, the author testified at the *Petersen* trial. In addition to the forensic podiatry evidence linking the suspect's footprint to the crime scene, investigators found the victim's blood in the suspect's residence, and the prosecution presented this additional evidence. The jury found the defendant guilty, and the judge sentenced him to life in prison without the possibility of parole (60).

In summary, the main arguments raised by defense counsel against the admissibility of forensic podiatry evidence in this case were (i) the lack of scientific criticism against forensic podiatry, and as such, a dearth of reliability; (ii) the fact that most scientific research concerning forensic footprint analysis utilized bare footprints, not sock-clad footprints, as was the case with footprints found at this crime scene; and (iii) the argument that a podiatrist is not needed to compare the suspect's footprint to crime scene footprint, which could be done by a layperson, suggesting that forensic podiatry is not science.

In response to these claims, the State argued that (i) the existence of substantial published and peer-reviewed research on forensic footprint analysis clearly established forensic podiatry's reliability; (ii) the understanding of how a sock-clad footprint translates to a surface, maintaining pertinent footprint morphology, combined with published research on sock-clad footprint evidence—established the forensic value of sock-clad footprint evidence; and (iii) the need for podiatrist's expertise to understand the complex interaction of the foot, influenced by motion, anatomy, pathology, body weight, and other factors, when interpreting a footprint.

Conclusion

This article shows the importance and applicability of forensic podiatry testimony with regard to footprint evidence, illustrated by the *Petersen* case in Wisconsin. Note that other disciplines are involved in the forensic analysis of footprints, and the legal nuances of other forensic cases involving footprints may vary, depending on the particular facts and circumstances of the case, the jurisdiction, and the approach of the specific discipline involved. Despite these limitations on the scope of this article, the understanding of the general principles of the *Daubert* standard for expert evidence and testimony applies to other forensic specialties, albeit from the perspectives of their own disciplines.

Daubert and *Daubert*-type challenges to forensic podiatry testimony are likely to increase as the specialty becomes more well known: Forensic podiatrists should expect to face such a hearing at some point in their career. In cases where the opposing counsel does not request a *Daubert* hearing prior to trial, the forensic podiatrist should prepare for *Daubert*-type questions when giving expert testimony in court.

To best prepare for a *Daubert* hearing, forensic podiatrists should stay current with the relevant research and scientific advances, should understand the *Daubert* standard and related cases, and endeavor to keep current with legal rulings and new government standards that may have an impact on forensic podiatry testimony.

When approaching analysis of forensic evidence in a case through to its conclusion, forensic podiatrists should adhere to *Daubert*-type concepts—employing proven, tested methodolo-

gies, and techniques. Ultimately, their findings will be stronger, and any *Daubert* challenge will be easier to defeat.

Lastly, forensic podiatry as a profession and its practitioners must remain vigilant to verify, appraise, and accommodate new and existing theories, methodologies, and techniques when appropriate to ensure that the highest legal and scientific standards are maintained.

References

- DiMaggio JA, Vernon DW. Forensic podiatry: principles and methods. New York, NY: Humana Press, 2011.
- Vernon DW, McCourt FJ. Forensic podiatry – a review and definition. *Br J Podiatr* 1999;2:45–8.
- Hamilton J. Scottish murders: from Burke and Hare to Peter Tobin. In: Kindle file, editor. Kindle Edition. Glasgow, Scotland: Waverley Books, 2013;709–825.
- Vernon W. The development and practice of forensic podiatry. *J Clin Forensic Med* 2006;13:284–7.
- DiMaggio JA. The role of feet and footwear in medicolegal investigations. In: Rich J, Dean DE, Powers RH, editors. Forensic medicine of the lower extremity. Totowa, NJ: Humana Press, 2005;375–400.
- Vernon W, Brodie B, DiMaggio J, Gunn N, Kelly H, Nirenberg M, et al. Forensic podiatry: role and scope of practice (in the context of forensic human identification). *Ident News* 2010;40:22–4.
- Frye v. United States*, 54 App. D.C. 46, 293 F. 1013 (1923).
- Daubert v. Merrell Dow Pharmaceuticals*, 509 U.S. 579 (1993).
- Pyrek K. Forensic science under siege: the challenges of forensic laboratories and the medico-legal investigation system. Burlington, MA: Elsevier Academic Press, 2007.
- Vanderkolk J. Forensic comparative science: qualitative quantitative source determination of unique impressions, images, and objects. Burlington, MA: Elsevier Academic Press, 2009.
- Moenssens AA, Henderson CE, Portwood SP. Scientific evidence in civil and criminal cases. 5th ed. St. Paul, MN: Foundation Press, 2007.
- Roisman AZ. Surviving the *Daubert* attack: staying focused. *Pract Litigator* 2003;14:43–6.
- General Electric Co. v. Joiner*, 522 U.S. 136, 118 S. Ct. 512, 139 L. Ed. 2d 508 (1997).
- Kumho Tire Co. v. Carmichael*, 526 U.S. 137, 119 S. Ct. 1167, 143 L. Ed. 2d 238 (1999).
- Roisman AZ. Implications of *GE v. Joiner* for admissibility of expert testimony. *Vt J Envtl L* 1998;1:65–77.
- U.S. v. Mooney*, 315 F.3d 54 (1st Cir. 2002).
- Ruiz-Troche v. Pepsi Cola of P.R. Bottling Co.*, 161 F.3d 77 (1st Cir. 1998).
- Zenith Electronics Corp. v. WH-TV Broadcasting Corp.*, 395 F.3d 416 (7th Cir. 2005).
- Committee on Identifying the Needs of Forensic Sciences Community. National Research Council: strengthening forensic science in the United States: a path forward. Washington, DC: National Academies Press, 2009.
- Fed. R. Evid. 702.
- Fed. R. Evid. 702 Advisory Committee note amendment (1972).
- See generally, *U.S. v. Mosley*, 339 Fed.Appx. 568, 573 (C.A.6 (Mich.) 2009); *Medcom Holding Co. v. Baxter Travenol Laboratories, Inc.*, 106 F.3d 1388, 1400 (C.A.7 (Ill.) 1997); *Kopf v. Skyrms*, 993 F.2d 374, 377 (C.A.4 (Md.) 1993); *Grindstaff v. Coleman*, 681 F.2d 740, 742 (C.A.Ga. 1982).
- Kaufman MS, and Atlantic Legal Foundation. The status of *Daubert* in state courts. New York, NY: Atlantic Legal Foundation, March 31, 2006.
- State of Wisconsin vs. Travis L. Petersen, No. 13-CF-38, (Waushara Cnty Ct. January 8, 2015).
- Wis. Stat. § 907.02 (2011).
- Blinka DD. The *Daubert* standard in Wisconsin: a primer. *Wis Law* 2011;84:14–9.
- Rich J, Dorothy DE, Powers RH, editors. Forensic medicine of the lower extremity. Totowa, NJ: Humana Press, 2005.
- Thompson T, Black S, editors. Forensic human identification – an introduction. British Association for Human Identification. Boca Raton, FL: CRC Press, 2007.
- Vernon W. The use of chiropody/podiatry records in forensic and mass disaster identification. *J Forensic Ident* 1994;44:26–40.

30. Kennedy RB. Uniqueness of bare feet and its use as a possible means of identification. *Forensic Sci Int* 1996;82:81–7.
31. Kennedy RB, Pressman IS, Chen S, Pressman AE, Petersen PH. Statistical analysis of barefoot impressions. *J Forensic Sci* 2003;48(1):55–63.
32. Kennedy RB, Sanping C, Pressman IS, Petersen PH, Pressman AE. A large-scale statistical analysis of barefoot impressions. *J Forensic Sci* 2005;50(5):1071–80.
33. Qamra SR, Sharma BR, Kaila P. Naked foot marks – a preliminary study of identification factors. *Forensic Sci Int* 1980;16(2):145–52.
34. Laskowski GE, Kyle VL. Barefoot impressions – a preliminary study of identification characteristics and population frequency of their morphological features. *J Forensic Sci* 1988;33(2):378–88.
35. Krishan K. Individualizing characteristics of footprints in Gujjars of North India – forensic aspects. *Forensic Sci Int* 2007;169(2):137–44.
36. Smerecki CJ, Lovejoy CO. Identification via pedal morphology. *Police Chief* 1984;51(4):52–4.
37. Barker SL, Scheuer JL. Predictive value of human footprints in a forensic context. *Med Sci Law* 1998;38(4):341–6.
38. Reel S, Rouse S, Vernon W, Doherty P. Reliability of a two-dimensional footprint measurement approach. *Sci Justice* 2010;50:113–8.
39. Bodziak WJ. Footwear impression evidence: detection, recovery and examination. 2nd ed. Boca Raton, FL: CRC Press, 1999;381–411.
40. State of Wisconsin vs. Travis L. Petersen, No. 13-CF-38, (Waushara Cnty Ct. January 8, 2015), at 61-62 (MS Nirenberg).
41. State of Wisconsin vs. Travis L. Petersen, No. 13-CF-38, (Waushara Cnty Ct. January 8, 2015), at 80 (SC Blader).
42. State of Wisconsin vs. Travis L. Petersen, No. 13-CF-38, (Waushara Cnty Ct. January 8, 2015), at 81-82 (MS Nirenberg).
43. State of Wisconsin vs. Travis L. Petersen, No. 13-CF-38, (Waushara Cnty Ct. January 8, 2015), at 88 (SC Blader).
44. State of Wisconsin vs. Travis L. Petersen, No. 13-CF-38, (Waushara Cnty Ct. January 8, 2015), at 92-93 (TL Nielsen).
45. Vernon W, Parry A, Potter M. A theory of shoe wear pattern influence incorporating a new paradigm for the podiatric medical profession. *JAPMA* 2004;94(3):261–8.
46. Vernon W. The functional analysis of shoe wear patterns [thesis]. Sheffield, U.K.: Sheffield Hallam University, 2000.
47. Lucock LJ. Identification from footwear. *Med Sci Law* 1979;19:225–30.
48. Charlesworth F. Chiropody theory and practice. London, U.K.: Actinic Press Ltd., 1961.
49. Gibbard LC. The interpretation of wear marks on shoes as an aid to the diagnosis of foot troubles: part 2. *Br Chirop J* 1958;23:231.
50. Hanby JH, Walker HE. The principles of chiropody. London, U.K.: Bailière, Tindall and Cox, 1949.
51. Vernon W, Parry A, Potter M. Consensus obtained in a Delphi study of shoe wear pattern experiences amongst podiatrists. *J Forensic Ident* 2003;53(1):15–41.
52. State of Wisconsin vs. Travis L. Petersen, No. 13-CF-38, (Waushara Cnty Ct. January 8, 2015), at 95 (TL Nielsen).
53. Hsu HS. (2015, Apr 18) FBI admits flaws in hair analysis over decades. *The Washington Post*; http://www.washingtonpost.com/local/crime/fbi-overstated-forensic-hair-matches-in-nearly-all-criminal-trials-for-decades/2015/04/18/39c8d8c6-e515-11e4-b510-962fcfab310_story.html.
54. State of Wisconsin vs. Travis L. Petersen, No. 13-CF-38, (Waushara Cnty Ct. January 8, 2015), Case No. 13-CF-38, at 97 (GD Dutcher).
55. State of Wisconsin vs. Travis L. Petersen, No. 13-CF-38, (Waushara Cnty Ct. January 8, 2015), at 98 (GD Dutcher).
56. State of Wisconsin vs. Travis L. Petersen, No. 13-CF-38, (Waushara Cnty Ct. January 8, 2015), at 99-100 (GD Dutcher).
57. State of Wisconsin vs. Travis L. Petersen, No. 13-CF-38, (Waushara Cnty Ct. January 8, 2015), at 100 (GD Dutcher).
58. State of Wisconsin vs. Travis L. Petersen, No. 13-CF-38, (Waushara Cnty Ct. January 8, 2015), at 104-106 (GD Dutcher).
59. State of Wisconsin vs. Travis L. Petersen, No. 13-CF-38, (Waushara Cnty Ct. January 8, 2015), at 107-108 (GD Dutcher).
60. State of Wisconsin vs. Travis L. Petersen, No. 13-CF-38, (Waushara Cnty Ct. January 8, 2015), at 108 (GD Dutcher).

Additional information and reprint requests:

Michael Nirenberg, D.P.M.

Friendly Foot Care, PC

50 West 94th Place

Crown Point

IN 46307

E-mail: DrNirenberg@FriendlyFootCare.com