Best's Insurance Law Podcast

Biomechanics and Impact on Cases - Episode #226

Posted: Wed., March 19, 2024

Hosted by: John Czuba, Managing Editor
Guest Expert: Grace Oswald from S-E-A
Qualified Member in *Best's Insurance Professional Resources* since: 2021

John Czuba: Welcome to "Best's Insurance Law Podcast," the broadcast about timely and important legal issues affecting the insurance industry. I'm John Czuba, Managing Editor of *Best's Insurance Professional Resources*.

We're very pleased to have with us today Grace Oswald from Qualified Member expert service provider, S-E-A. Grace Oswald joined S-E-A after she received both her Master of Science degree in Biomedical Engineering and her Bachelor of Science degree in Biomedical Engineering from The Ohio State University.

Ms. Oswald has experience with new product introduction, manufacturing engineering in the field of surgical robotics, where she worked in conjunction with research and development teams to modify designs for manufacture during initial builds.

At S-E-A, Ms. Oswald applies her engineering education and skills, as well as her anatomical knowledge to aid in the forensic evaluation of a variety of incidents.

Ms. Oswald's practical experience includes resolving unwitnessed slip, trip, and fall cases and unwitnessed falls from heights, analyzing pedestrians-and-vehicle accidents, analyzing cyclist-and-vehicle accidents and minor impact collisions, evaluating various premise liability circumstances, and also exploring human product use and misuse cases.

Grace, we're very pleased to have you with us today.

Grace Oswald: Thank you. I'm really happy to be here.

John: Today's discussion is on biomechanics and its impact on cases. Grace, for our first question, can you please tell our audience, what is biomechanics?

Grace: Definitely. When you think about it, biomechanics can be sort of explained by its name. We're using traditional mechanical principles on a specialized system, the human body. Hence the bio part of biomechanics.

Throughout this talk, because of the wide variety of backgrounds that various practitioners of biomechanics can have, I'm going to be referring to those practitioners as biomechanists.

Biomechanics is almost an umbrella term. It can refer to a wide variety of things, from the micro scale study of how cells respond to load, which is often used in medical fields, to the study of human movement, referred to as kinesiology, which you frequently see in sports medicine. A lot of pro athlete teams have a kinesiologist on their roster.

It can also include the biomechanics that we tend to think of in the forensics field, which is macro scale and usually examines injury thresholds. Tools for biomechanical explorations can range from specialized equipment, such as crash test dummies, to traditional investigative tools, such as force plates.

Our research can vary anything from experimental testing on human surrogates to virtual testing with finite element modeling and modeling softwares that have virtual versions of human surrogates embedded in them.

In the forensics sphere, biomechanics can refer to other disciplines and is often most frequently grouped together with human factors. Some biomechanists can opine on human factors, but for specialized topics, such as common sense, user expectations, and the difference between unexperienced and experienced users, increased training is required.

John: Grace, you said earlier that a large part of your role at S-E-A is investigating injuries. What are those investigations based on?

Grace: Those investigations are really based on a core foundation of the application of traditional principles of mechanics. When you break it down, the human body and its structural components can really be referred to as either springs or beams, with springs encompassing our muscles, tendons, and ligaments and beams really referring to our bones.

Everyday muscle movement can occur without significant wear. A good analogy here is, if you take a rubber band, you can pull it a lot before it breaks, but at a certain point, if you pull too much, it fractures. Our muscles, tendons, and ligaments, in conditions outside of their design envelope, fail for much the same reason. They are simply not designed to be stretched that much.

We use our activities of daily living to glean information for a specific person's muscle strength. An active individual, one that exercises multiple times a week or weight lifts or something like that, will have a much higher voluntary exposure limit, or something they're willing to expose their body to, than somebody who lives a more sedentary lifestyle or who has been in prior accidents.

When we're talking about bones, a key thing to keep in mind is that the material property of bone varies drastically based on the load direction. This really makes sense when you think about the everyday load pattern of bones. Most of our bones are used to compression from walking and activities of daily living such as that.

Our bones fail very similarly to other engineering components, such as a soda can, when it's being stepped on, fails in buckling, the same way a bone that is experiencing too much compressive force fails.

Additionally, our bones can experience failure in shear. A good example of this is when you take a pencil, and you bend it to break it. That is how our bones fail when there is a force applied perpendicularly to how we see it in everyday living.

Our bones have been incredibly well-characterized via all the human surrogate research studies that have been done in the field of biomechanics. Biomechanists use these well-characterized material properties, the activities of daily living, and injury thresholds gleaned from research to analyze the comparative exposure of incidents as the basis for analysis.

John: Grace, a common misconception could be that biomechanics face the challenge of straying into territory that's typically associated with a medical doctor. Can you explain the difference between someone like yourself and an independent medical examiner or a treating physician?

Grace: I definitely can. This is a very important question. It's quite frequently a topic of debate among the field of biomechanics. Medical practitioners traditionally offer treatment, diagnosis, and prognosis of injuries.

I like to say that they work forward from the injury and treat based on the description that the patient gives them and basically use a time frame correlation to indicate causality. A patient walks into a clinic or is brought into a clinic and says, "Today I fell, and now my leg is broken." The doctors say, "Awesome. That makes sense. We're good to go."

Biomechanists, at least ones with similar backgrounds to myself, almost work in the opposite direction. We do not seek to offer treatment, diagnosis, or prognosis of injury. We instead use that information from the medical doctors as key evidence in our analysis. These medical records allow us to work backwards to ascertain an injury mechanism associated with each relevant condition or diagnosis.

John: Grace, besides the medical doctor versus biomechanist debate, are there any other common misconceptions in your field?

Grace: Definitely. Following the whole medical doctor versus biomechanist debate, the next most misconception is that biomechanists cannot help once there are objective signs of acute injury.

In this sense, when I talk about objective signs of acute injury, I'm talking about objective in the sense that it is something that you can see or touch, something that shows up on an X-ray or an obvious sign of a fracture, where subjective injuries refer to pain or confusion or something along those lines.

Acute injuries refer to stuff that has a rapid onset, whereas degenerative injuries are things such as slipped discs or herniations which can occur over a wide course of time. Examples of an objective acute injury would be brain bleeds or fractures or something along those lines.

This misconception really started because, traditionally, biomechanists are viewed as a way to address damages, but that is not inclusive of our capabilities. When we have objective signs of acute injury, it really allows us to sink our teeth into a niche that really only biomechanists can fill and allows us to play to our specific strengths.

By analyzing injuries known to have occurred in an incident, we can frequently address the liability claims by determining if a specific claim could have occurred in an incident as it is being alleged or if there's some other factor at play.

John: Grace, you mentioned the belief that biomechanists can't help in cases where there are objective signs of injury, such as acute fractures or rapid-onset brain bleeds or hematomas. Do any other specific cases come to mind with these types of scenarios?

Grace: Definitely, yes. One of my first cases that I worked here at S-E-A actually had this objective sign of an acute entry. In the subject case, there was a claim that a ladder spontaneously failed while an individual was on it, allegedly resulting in the individual falling backwards and landing directly on their feet and suffering a broken femur.

When we received the X-ray films for the broken femur, we were able to determine that the two ends of the broken femur were not shoved towards each other, which is a very clear indication that there was a lack of compressive loading going on.

If you think about it, if you're experiencing a force from the feet upwards, you would expect the femur to be broken in such a way that the two ends almost get forced past each other. Further analysis of the X-ray displayed a V-notch fracture pattern in the femur, which is very indicative of three-point bending, such as that pencil that I referred to earlier.

By doing a comprehensive review of the evidence, we were able to determine that the femur was essentially broken across the rung of the ladder, which then subsequently resulted in the ladder being overloaded and failing.

By determining that the break preceded and directly contributed to the failure of the ladder, we were able to adjust the liability aspect of the claim based on that objective sign of acute injury.

When I talk about brain bleed analyses, these do heavily rely on having the proper documentation of the injury. In situations with claims of landing on the head with very few other injuries, we can correlate the injury to the head and the hematoma to an objective injury scale based off of the size of the brain bleed.

This objective injury scale can then be related to an injury metric that is a function of acceleration and time. By phrasing the injury as a function of this acceleration and time, the impact the velocity of the head at the time of impact can be calculated. From that, the fall height can be determined.

This allows us to address the liability claim by really figuring out where the claimant fell from. Did they fall from a balcony from two or three feet up, or was it simply a fall from standing?

John: Grace, besides these cases where there are objective signs of injuries, are there other types of cases that you feel biomechanists are perhaps underutilized on?

Grace: Definitely. Biomechanists are typically seen as an easy way to adjust low-speed vehicle collisions, but that is not at all that we do. Two genres of cases that we are underutilized on that I find particularly interesting are scald cases and slip and fall cases.

When I talk about scald cases, I'm referring to cases in which there is an allegation of a burn as a result with water or a liquid that is mostly water. Think coffee or tea or something like that. In these instances, we have a two-pronged approach, a qualitative assessment of the burn pattern and a quantitative assessment of the burn severity.

This qualitative assessment of the burn pattern really examines if the burn pattern lines up with the incident as it is being alleged. For example, if somebody is stating that they were holding on to a coffee cup and it exploded, resulting in burns, but they only have burns on the palm of their hand, that doesn't really make sense.

In that scenario, you would expect to see burns on the forearm and even on the feet, if somebody was not wearing shoes. This quantitative assessment of burn severity really analyzes the severity of the burns, first degree, second degree, third degree, based on a function of the liquid temperature and the exposure time.

If somebody is alleging third degree burns as a result with -- I don't know -- hot tap water, we would go and measure how hot the tap gets and correlate that with the amount of time it would be required to get the burn severity being alleged. Oftentimes, through this analysis, we can examine whether or not the incident as alleged really makes sense.

Together, this quantitative and qualitative assessment can inform us on not only would the exposure be expected to cause burns, but also if the alleged associated burns are in an incorrect location.

When I talk about slip and fall cases, I also frequently refer to them as gait and balance cases because that is what is being examined on the biomechanist's side. When you think about it, bipeds like humans are actually really quite unstable. You would never choose to sit down on a two-legged stool because every time you move back and forth, it would rock with you.

When you get to human movement, it's not really too much of a simplification to say that walking is really just continuous almost falling and then catching yourself. Because of that, abnormal gait can quickly lead to falls and injuries.

When we're exploring trip and fall incidents, a common tactic is to investigate if the alleged obstruction actually changed a person's gait or if it was abnormal prior to any external force. This can be done by calculating a person's center of gravity at various points in time and then seeing what it is in relation to the support provided to them by their own two feet.

This method, in addition to being really technologically sound, often leads itself to amazing visuals of why falls occurred. If you think about it and break it down frame by frame, tracking that center of gravity and where it is located with regards to the base of support really allows you to see at which point it was an unrecoverable movement that would have led to a fall.

John: Grace, before we wrap up today's discussion, do you have anything else you'd like to add for our audience?

Grace: I do. Thank you so much for asking. Honestly, if people are to take away one thing from this, I really want it to be that more often than not, if a person is involved in an incident, there is a way that a biomechanist can help.

There does not need to be some dramatic injury or some dramatic difference between the incident as alleged and the claimed injury. It can be as simple as someone falling forward as opposed to backwards in a video frame. If something seems off, there's more often than not something that we can investigate.

John: Grace, thanks so much for joining us today. That was a very informative podcast.

Grace: Thank you.

John: You were just listening to Grace Oswald from qualified member expert service provider, S-E-A. Special thanks to today's producer, Frank Vowinkel. Thank you all for joining us for "Best's Insurance Law Podcast." To subscribe to this audio program, go to our web page, www.ambest.com/professionalresources. If you have any suggestions for a future topic regarding an insurance law case or issue, please email us at lawpodcast@ambest.com.

I'm John Czuba, and now this message.

Transcription by CastingWords