

CRITICAL ISSUES IN RECONSTRUCTING ATV, SNOWMOBILE

By Nathan Bjerke and Seth Bayer, P.E.

The Minnesota Department of Natural Resources reports that since 2003, snowmobile crashes have caused more than 500 injuries and 81 deaths; and ATV crashes have caused more than 1,000 injuries and 86 deaths.¹ Without early and careful investigation of these crashes, evidence will be missed and reconstructions will be incomplete.

Reconstruction clues in these cases are often more subtle than in car crashes: a broken branch, a track made in the snow or mud. And we often don't have the benefit of a police report. As the amount of objective physical evidence decreases, the likelihood for variability between the parties' reconstructions increases.

This article – written by a reconstruction expert and a lawyer – discusses how the reconstruction expert and lawyer must work together in off-road vehicle crashes. It is based on the premise that attorneys cannot simply hire experts to form opinions and let the jury sort out which side's expert is right. Rather, lawyers must study the science behind the reconstructions, trade in our wingtips for work boots; get out from behind our desks to inspect vehicles and scenes. In short, our experts must work with us, not for us. If the lawyer doesn't get involved, she will miss critical evidence; evidence that may make or break the accuracy of the reconstruction and in turn, her client's case.

THE IMPORTANCE OF UNDERSTANDING RECONSTRUCTION PRINCIPLES

Reconstruction is like putting together the pieces of a puzzle. Except the pieces don't come in a box – they need to be dug up, sometimes literally. And the team that gathers the most pieces will put together the most complete and reliable picture of what happened. The lawyer's primary role in the expert-lawyer relationship is to provide the data, or puzzle pieces.

And to gather needed evidence, the lawyer

must understand what evidence is critical and why. Without that knowledge, our questions in deposition or interviews will miss the mark. When accepting any case involving reconstruction issues, talk to your expert about good texts or articles needed to educate yourself on the issues in the case.

THE RECONSTRUCTION TRIANGLE

Like any motor vehicle crash, the pieces of a recreational vehicle puzzle can be sorted into three boxes:

1. Human/operator;
2. Environment; and
3. Vehicle.

The human aspect focuses on operator input. Environment focuses on terrain and may include variables such as inclines or friction coefficients of the terrain due to things like snow or mud. The vehicle aspect focuses not only on vehicle defects or malfunctions, but also inherent design characteristics that tell us how a vehicle responds to operator input as well as how the environment will affect the vehicle's travel.

The expert-lawyer team must investigate and examine all three of these factors in a recreational vehicle case for at least two reasons. First, it is the lawyer's job to explore all possible avenues of recovery.

For example, was the crash caused by defendant's bad driving?

Was there something inherently dangerous about the environment such that the landowner may be liable? Or was there a problem with the vehicle that gives rise to a product liability claim? Second, if a plaintiff's liability claim is based on one factor (e.g. a product or vehicle problem), the defendant will almost certainly point to

one of the other factors as the cause of the crash (e.g. human/operator input).

OPERATOR

As lawyers, it is typically our job to gather information concerning the human/operator aspect of a recreational vehicle crash. Our primary tools are the medical records, interviews and depositions.

Operator – Medical Records

The medical records are important because a person's injuries often provide clues about how a crash happened. Critical care records should be provided to the reconstruction expert. While the reconstruction expert may not be qualified to render opinions concerning injury causation or mechanisms, they should be provided the critical care records to assure the injuries are generally consistent with the reconstruction. For example, if an ATV rolls over an operator, it is helpful for the reconstruction expert to know which side of the rider's body sustained road rash. For example, damage to her left side could assist the opinion that the ATV rolled to the rider's left. Rips and tears in clothing can also provide valuable clues.

Operator-Interviews and Depositions

As lawyers, good interviews and depositions are our best chance to arm the reconstruction expert with valuable operator information. The lawyer and expert should speak before an interview or deposition to discuss those pieces of the puzzle the expert needs to create a better overall picture. In

other words, the expert must convey her thoughts on what information the lawyer should attempt to gather during the deposition of scene witnesses. Topics concerning the operator corner of the reconstruction triangle include:

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AND OTHER OFF-ROAD CRASHES

- Operator's training and experience operating all kinds of recreational or off-road vehicles;
- Operator's familiarity with this vehicle or similar vehicles;
- Speed estimates;
- Amount of throttle applied (this would include both questions for the operator including application of throttle as well as engine sound from other witnesses);
- Steering input in terms of degrees. Ask these question to both operator and other witnesses who were in a position to observe the steering inputs;
- Braking input (including whether the front, rear or both brakes were applied and if so, when, how hard the brakes were applied, whether the application was gradual or sudden, and how long the operator applied the brakes);
- Observations or recollections concerning body/weight shifting and positioning; and
- Approximate distances and speeds from initial observation of hazard to crash.

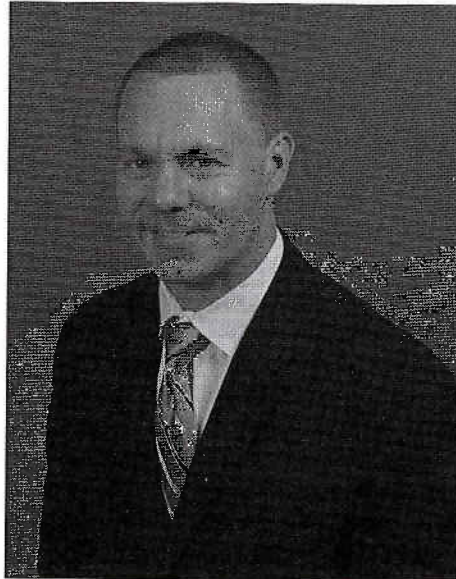
Also ask for operator height and weight at the time of the crash since these factors may impact the reconstruction.

THE ENVIRONMENT OR SCENE

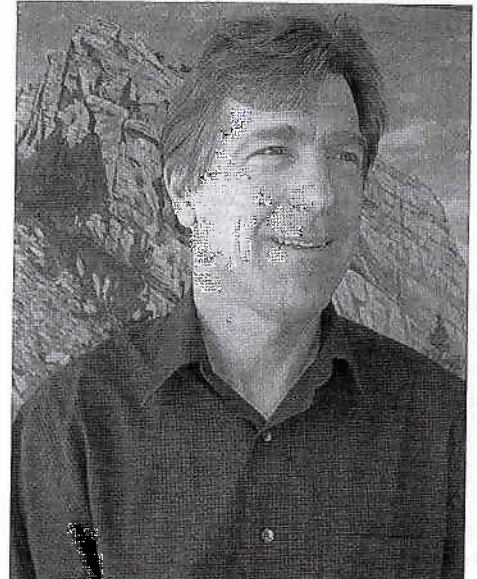
The lawyer and expert should work as a team to gather evidence from and concerning the scene. Lawyers know more about the case as a whole than the expert and thus should be present when the expert inspects the scene to share information as issues arise. Further, lawyers who get their shoes and hands dirty inspecting scenes simply know more about the crash and their clients' cases than lawyers who don't.

Environment – Scene Inspections

In recreational vehicle crashes, it is critical to thoroughly inspect, measure and



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photograph the scene as soon as possible. Unlike concrete freeways, the general character of off-road crash scenes can change quickly. A good soaking rain or snow may not only wash away marks in the terrain, it could change the overall character of the terrain by washing away dirt or mounds. Likewise, vegetation changes can remove clues. Broken branches may fall off and grow back. In short, you and your expert need to inspect and document the scene as soon as possible. And if possible, have scene witnesses come with you to show you pertinent locations.

Environment – Interviews and Depositions

Most reconstruction experts also like scene diagrams – preferably from first responders. If there were first responders, be sure to interview and depose them to dig into the details of the scene diagram, the methods used to create the diagram and take measurements taken.

If there is no first-responder scene diagram – or even if there is – bring 8 x 10 photographs of the scene taken during your inspection to the deposition or interview. Have the witness write on the photograph to indicate:

- Location of the crash or impact;

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Reconstructing Crashes - Cont.

- Rest position of the persons and vehicles involved, including estimates of distances between the rest positions and the point of impact;
- Location of other disturbed terrain. This may provide clues as to the path of the occupants or vehicles both before and after the crash;
- Nature of the surface driven over. The more information the better. For example, there are all kinds of dirt surfaces. What the dirt packed hard? Was it muddy? Was it soft? Soft

enough that the witness' feet sunk in when he walked? Was it dry and dusty?;

- Temperature at the time of crash and for 48 hours prior;
- Location and size of significant land marks like tree stumps, dirt mounds, or boulders; and
- Location (including height) of broken branches, cuts or gouges in trees or other landmarks.

Environment – Tire Tracks

Tire or track marks are also critical. Lawyers must question the witness concerning the location, length, shape and character of marks. There are three principle types of tire marks: skidding, rolling and yaw marks.

As the name suggests, a skidding tire mark is caused when the tire is skidding across a surface. In off-road crashes, the dirt, snow or gravel will be pushed forward and there will not be a distinct tire tread pattern. Conversely, a rolling tire leaves marks with a clear track or tire pattern. The

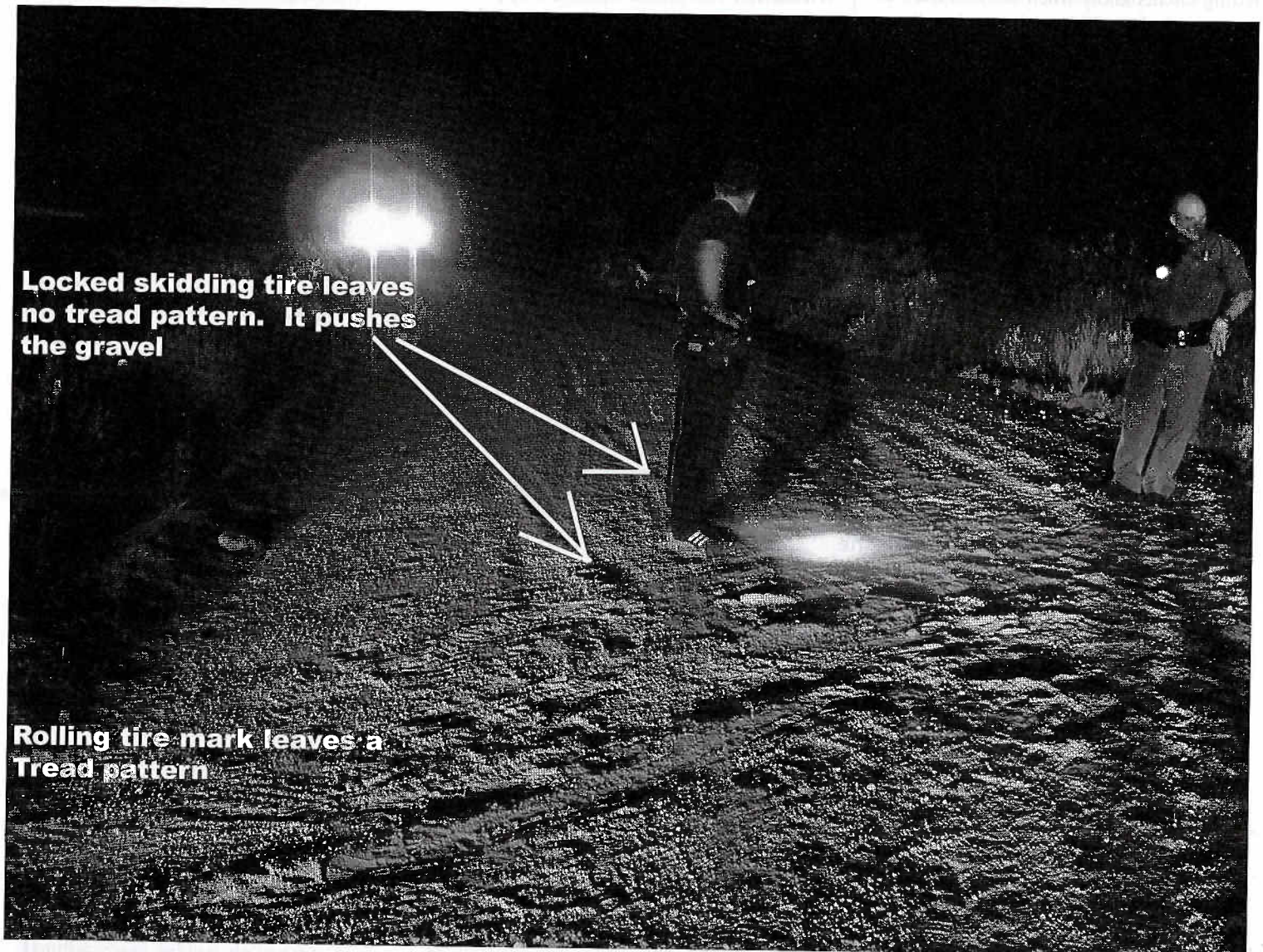


Figure One: Illustration showing a rolling tire mark and a locked skidding tire mark

Reconstructing Crashes - Cont.

photograph in Figure 1 demonstrates the difference.

A yaw mark is a mark made by a tire that is rolling and sliding sideways due to cornering forces. When the tire reaches the limit of the available friction while cornering it will slide radially outward. This mark is characterized by a visible tread pattern that leaves a mark sliding outward.

Environment – Calculating Estimated Speeds

Armed with evidence concerning the vehicle's rest position and the length and character of tire marks, we may have enough data to estimate the vehicle's speed at the beginning of the crash sequence using some high-school level physics.

But before calculating an estimated start speed, we need to determine an appropriate coefficient of friction. The coefficient of friction is the amount of friction (force) acting on the tires, and is influenced by the weight of the vehicle, the roadway surface (asphalt, gravel, etc.) and weather conditions (rain or ice). The higher the coefficient of friction, the more quickly a vehicle scrubs off speed. Coefficients of friction vary from surface to surface. For example, icy scenes have a lower coefficient of friction than dry asphalt scenes. Further, friction coefficients for snow and ice may vary with temperature. Thus, the team should gather weather records for at least 48 hours before the crash.

The following is how the variables discussed above work mathematically to calculate estimated speeds. Before your eyes glaze over at the thought of doing (or in this case following) math, consider how useful this speed calculation can be in your practice. If you know it, you can estimate speeds to help determine whether a new case is viable even before spending money on experts. Or if the defense reconstruction expert tries to bury you in technical blather, you can run this calculation in front of the jury to show

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them you really know what you're talking about.

If a vehicle slides or rolls to a stop in a relatively straight line rather than stopping when it hits something, you can calculate velocity when the vehicle started to leave tire marks with the equation $V_i = \sqrt{2AD}$. In this equation:

- V_i is the initial velocity in feet per second;
- $2A$ is 2 times the acceleration of gravity (a constant 32.2) times the coefficient of friction; and
- D is the distance of the skid marks in feet.

In off-road crashes, a typical coefficient of friction for dirt or gravel on a level surface is 0.5 to 0.7. If we assume we have 60 feet of tire marks before the vehicle slides to a stop, the equations are:

- $V_i = \sqrt{2(32.2)(0.5)(60)}$ – assuming a 0.5 coefficient of friction; and
- $V_i = \sqrt{2(32.2)(0.7)(60)}$ – assuming a 0.7 coefficient of friction.

These calculations reveal initial velocities, or V_i range of 43.95 feet/second (assuming a 0.5 coefficient of friction) to 52.01 feet/second (assuming a 0.7 coefficient of friction). To transfer feet/second to miles per hour, simply multiply feet/second by .68. The final initial velocity when the vehicle started leaving tire marks is 29.88

mph to 35.37 mph.

VEHICLE

The vehicle in off-road crash cases often contains critical evidence. First, a thorough technical analysis of vehicle damage may be critical to understanding the magnitude and direction of applied forces. Or in some cases, broken components may tell the story of why the crash happened. Thus, vehicle preservation is critical. If your client does not own the vehicle, try to buy it. If you can't buy it, move the court for protection or an injunction preventing the owner from destroying the evidence.

Vehicle Inspections

The lawyer and expert should inspect the vehicle together. Again, lawyers know more about the case than the expert but the expert will likely know more about the vehicles and the way they work. (The lawyer member of this writing team has learned more by attending vehicle and scene inspections and asking questions than by reading treatises and texts.) Before the inspection, arrange for proper inspection logistics. For example, will the expert need to disassemble anything? If so, you will probably want to circulate a protocol ahead of time. Likewise, determine whether the inspection will

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** Cathedral of St. Mary: Built by my grandfather, c 1903*

and magnitude involves surveying the damage to a vehicle, comparing the damaged profile to an undamaged profile and quantifying the displacement or movement of the damaged structure. Based on the direction of movement, it is usually possible to identify the direction of force application. The magnitude of the force can be calculated if the "stiffness" of the vehicle is known. That is it is assumed the vehicle compresses like a non-rebounding spring, and if the spring constant is known, force can be calculated. Force is equal to the spring constant times the distance the spring is compressed. Usually for off-road vehicles such as ATVs and snowmobiles this data is not available and other methods must be used to calculate force magnitude. If data regarding speed is known, force can be calculated based on a stopping distance. If the stopping distance is short such as in hitting a tree forces are generally high, and this

questioning include:

- Operation of throttle – any experience concerning lag in throttle return, slow response to throttle input or throttle catching during this crash event or prior;
- Operation of brakes – did the brakes feel spongy, make any unusual sounds or emit any unusual odors at any time during or before this crash?;
- Steering system – was there any catching, lagging or roughness in turning or problems with stability that may have been caused by overall poor vehicle geometry or suspension defects; or
- Transmission – were there any problems with the suspension catching or jerking.

The team must also research the vehicle's history. Pre-suit, this must include determining whether the vehicle has ever been subject to a recall or similar consumer complaints. For ATVs, snowmobiles and personal water craft, this information is made available by the Consumer Product Safety Commission (CPSC) at www.cpsc.gov.

require special equipment that must be arranged ahead of time – such as a vehicle lift.

While it is critical to inspect all parts of the vehicle, special attention should be paid to:

- All brakes, including brake lines and components;
- Throttle/acceleration system including cables, carburetors or fuel injectors, and throttle mechanisms for sticking;
- Steering mechanisms and joints;
- Suspension systems and joints;
- Wheel or track attachments; and
- Transmission.

It is also important to analyze damaged or broken vehicle components to help determine the amount (magnitude) and direction (vector) of force applied to the vehicle. Determining the force vectors

can easily be shown mathematically.

If an off-road crash involves more than one vehicle and one of the vehicles is not available for inspection, all may not be lost. Newton's Third law states that for every force there is an equal and opposite force. So that for any vehicle striking another vehicle or object there will be an opposite force of the same magnitude, but opposite direction. This is useful if the damage to one vehicle is known but the other vehicle is not available for inspection. In cases like these, the reconstruction expert can still say with absolute certainty that the missing vehicle experienced the same force as did the vehicle available for inspection.

Vehicle – Witness Interviews and Depositions

When deposing or interviewing witnesses concerning vehicle issues, lines of

CONCLUSION

If you take on an off-road vehicle case, involve an expert early. And don't just have them work for you – instead work with them. Make sure you understand the science and math they are using to reconstruct your client's crash. If you follow these steps, you will gather more evidence and give your client a better chance of maximizing her recovery. Besides, isn't getting dirt under your fingernails more fun than sitting behind your desk all day?

¹ For more information on Minnesota DNR ATV and snow mobile accident statistics, visit <http://www.dnr.state.mn.us/enforcement/incidentreports/index.html>