Episode Book

EPISODE #5783

Can a Dremel Be Gym Equipment?

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SYNOPSIS

If a power tool does the work, why are you sweating? A hobbyist's afternoon engraving HDPE storage boxes with a corded Dremel turned into a real research question: has anyone actually quantified the physical intensity of operating a power tool? The answer is yes — but almost entirely for industrial nutrunners and assembly-line tools, not the rotary tool in your garage. This episode digs into reaction torque, lever arm geometry, substrate hardness flipping the ergonomic sign, and why experienced operators brace harder instead of working lighter. It ends somewhere unexpected: the unit of measurement in this field is injury, not fitness — which quietly answers the workout question before it's even asked.

TRANSCRIPT



Corn

Here's the question that started all of this. If a power tool does the work, why are you sweating?



Herman

That's the whole paradox in one line, and I love that it came from a real afternoon rather than a thought experiment.



Corn

It came from Daniel, who spent a few hours with his corded Dremel engraving durable identifiers into HDPE industrial storage boxes for his home inventory system. His words: "by the end of it, I was more than breaking a sweat."



Herman

And he's not being dramatic about it.



Corn

He isn't. His point is that operating a rotary tool safely on a hard material like HDPE takes serious counter-force. You're pushing and holding and bracing the whole time, and the tool itself is fighting you in ways you don't notice until your forearm starts complaining.



Herman

He said something I want to hang onto. That there's something inherently paradoxical about it, because you think power tools mean labour stops being physical.



Corn

Right. And then he followed that thread where you'd follow it. Have ergonomics and workplace health and safety people actually tried to benchmark this? Quantify the physical intensity of operating different tools? He names the variables himself, the substrate, the



Corn (continued)

break frequency, the weight of the drill.



Herman

And then he lands the big one.



Corn

Can operating a power tool be a strength workout? Let's find out what the research says, and whether anyone has ever framed a Dremel as gym equipment.



Herman

The first thing to get straight is that the reaction force isn't a design flaw. It's physics. When a powered tool's spindle reaches its target torque and stops, the rotational energy has to go somewhere. It goes into the handle, and the handle goes into your hand and arm.



Corn

So the operator becomes the anchor.



Herman

The operator becomes the anchor. You have to exert force in the opposite direction to hold your posture and your balance. Ava Mazaheri's 2018 thesis at KTH in Stockholm puts it in one sentence that I keep coming back to. She writes that "the shift in power source does in many cases imply that the magnitude of forces and torques generated by the tool is beyond the limit to which the operator can counteract without being prone to injury."



Corn

Read that back to me, because the second half is the part that matters.



Herman

Beyond the limit to which the operator can counteract. If the force exceeds what you can resist, your hand and arm is suddenly pulled away in the direction of the torque. That's not a workout. That's the tool winning.



Corn

And that's the thing. The whole sales pitch of a power tool is that it removes force generation from the human body. This says the tool can generate more force than the body can safely handle in return. You traded one physical demand for a different one.



Herman

Which is exactly what Daniel felt on the HDPE. And it's not a niche curiosity. Up to seventy percent of operators in automotive use power tools. Another source puts power tools at roughly seventy-five percent of the tools in a manufacturing plant. This is a huge fraction of industrial work, and the USCAR white paper admits it directly, that despite the prevalence of these tools, it's been historically difficult to assess the physical demands of operating them.



Corn

Difficult, but not impossible, because they did measure it. Where do you want to start?



Herman

The mechanism, because it explains the HDPE case specifically. The reaction force at the contact point follows force equals torque divided by distance. That distance is from the drive to the point where you're holding. A longer handle is a lever, and a longer lever means less force you have to resist.



Corn

So a long breaker bar is easier on your hands than a stubby wrench at the same torque.



Herman

Much easier. And that's the problem with a Dremel. The body is compact. Your hand is right up near the spindle, so the lever arm is short, so the force the hand-arm system absorbs is large. The tool is shaped for precision, and the price of that precision is that you take more of the reaction.



Corn

Compact and precise versus easy to hold. Those fight each other.



Herman

They always have. Now put it on HDPE. The tool spins anywhere from five thousand to thirty-five thousand RPM, and for cutting plastic you're recommended to stay down at five to fifteen thousand, because above that you melt the material instead of cutting it.



Corn

And melting means the bit grabs.



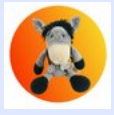
Herman

Melting means the bit grabs, the flutes clog, and a grab is a kick. So for most of that job you're not fighting one big torque spike. You're stabilizing against rotational and vibrational loads, holding a feed force to advance the cut, and absorbing every kickback when the bit catches. It's a continuous load, not a single jolt.



Corn

Which is worse for the arm, in a way. A single jolt you can brace for. A continuous load you just endure.



Herman

And this is where the substrate variable gets interesting, because it flips depending on the tool. For a nutrunner, a hard joint is ergonomically better. When the joint is hard, the tool reaches torque in a fraction of a revolution, and the handle displacement is small.



Herman (continued)

When the joint is soft, there's more rotation before it seats, so the reaction delivered to the operator is higher.



Corn

So hard joints are kinder to a nutrunner operator.



Herman

Kinder there. Now go to a Dremel on HDPE. Dense, hard material means more feed force to push the bit through, more resistance, more kickback when it grabs. The same property, hardness, that helps the nutrunner operator, hurts the person with the rotary tool in their hand.



Corn

The variable doesn't have a direction. It has a direction per tool.



Herman

That's the part most people get wrong. Hard substrate isn't "harder on the worker." It's harder on this worker with this tool. Change the tool and the sign flips.



Corn

Okay, so substrate is one variable Daniel named. He also named frequency and weight. What does the research say about frequency?



Herman

Frequency is well documented. As the number of joints fastened per minute increases, going from one per minute up to five per minute, the maximum acceptable force decreases. You can tolerate less force per event when the events come faster, because you don't get the recovery between them.



Corn

Same total work, less time to recover, so the ceiling drops.



Herman

And it drops measurably. There's also posture. For piston-grip tools used on vertical surfaces, as the working height increased by thirty centimetres, the odds of an unacceptable rating over an acceptable one went up by a factor of one point six.



Corn

Thirty centimetres. That's a shelf height. You'd never think a shelf height could move a safety rating, and there it is, one point six times.



Herman

Tool weight matters too, and weight isn't just the number on the box. A battery pack on the back or a hose hanging off the side shifts the centre of gravity, and that changes the support force you need. You're not just carrying the tool. You're carrying the tool in a configuration.



Corn

I want to come back to the Dremel specifically, because Daniel's asking about a tool that people mostly use in a garage.



Herman

And here's the honest answer: nobody has studied that. I went looking. PubMed returns zero citations for rotary tool grinder operator muscle fatigue. There's no Dremel-specific ergonomics study. The quantified work is almost entirely on industrial nutrunners, drills, and impact tools in automotive and construction settings.



Corn

So the garage hobbyist is off the map.



Herman

Off the map. There's also no HDPE-specific cutting-force ergonomics anywhere. The HDPE machining literature is all about surface finish and temperature, whether the cut is clean, whether the material melts. Nothing about what it does to the person holding the tool.



Corn

The material gets studied. The hand doesn't.



Herman

And that gap is the interesting thing. Daniel's exact scenario, a hobbyist with a rotary tool on hard plastic in a home workshop, sits in a hole in the literature. He's feeling something real that nobody has bothered to measure.



Corn

So let's shift to the question he actually wants answered. Has anyone benchmarked this? And the answer, from what you've got, is yes, just not for his tool.



Herman

Yes, and the flagship example is impressive. There's a USCAR white paper dated May third, twenty twenty-two, summarizing Dr. Joel Cort's 2018 research at the University of Windsor. That was a collaboration with Ford, General Motors, and Stellantis.



Corn

All three of the big automakers in one room, which tells you they had a reason to care.



Herman

A very expensive reason. What they built is the part I love. An instrumented tool called the RAPT-FH, the Right-Angle Power Tool Force Handle. It's a handle that measures hand force during real operation, on the line, with the actual tool doing the actual job.



Corn

They built hardware to find out how hard the human is squeezing.



Herman

They built hardware to find out how hard the human is squeezing, because they needed a number. And they used it to establish what they call Physical Capability Limits. The maximum exposure an individual can tolerate without added adverse health effects.



Corn

So not "what's comfortable," not "what's a good workout."



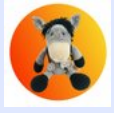
Herman

What can the body absorb before health starts to degrade. That's the frame the whole field uses.



Corn

Which answers the workout question before we even get to it, doesn't it. The unit of measurement is injury, not fitness.



Herman

Keep that in your pocket for the end. There's another study I want to bring in, because it's the counter-intuitive one. Lin and McGorry, Ergonomics, 2007. Fifteen experienced nutrunner users against fifteen novices. They measured handle displacement and muscle activity.



Corn

And the experienced users were more efficient.



Herman

The experienced users let the handle move about seven point nine degrees, against eleven point five degrees for the novices. So yes, less movement. More control. But then they looked at the muscle activity, and the experienced group's forearm flexors were firing at three hundred and eighteen percent of reference voluntary contraction. The novices were at two hundred and forty-six. Biceps, one hundred and forty-three percent experienced against one hundred and thirteen percent novice.



Corn

So the experienced people let the tool move less, and their muscles worked harder.



Herman

Harder. They brace. Experience doesn't make the job lighter. It changes the technique from absorbing the motion to resisting it, and resisting it costs more muscle activity.



Corn

They're doing the opposite of relaxing into it.



Herman

They've learned that letting it move is how you get hurt. So they lock up and take the load, and the electromyography shows it. That's a strength-endurance demand, not a lighter one.



Corn

Which is a useful thing for anyone who thinks the experienced guy has it easy.



Herman

There's a third study that I think is the most provocative of the set. Gaudez, Wild, and Aublet-Cuvelier, Applied Ergonomics, 2015. They compared fitting clips with a bare hand, with an unpowered tool, and with powered tools.



Corn

And the powered tool was the lightest.



Herman

None of the four fitting methods induced a lower overall workload than the other three. That's the finding. And the conclusion they draw is sharp. Measuring external force only, as recommended in several standards, is insufficient for evaluating physical workload.



Corn

So the standards that tell you how to assess this are measuring the wrong thing.



Herman

They're measuring the force at the tool, and the load on the person is somewhere else. You can have a tool that pushes less and still tires the operator more, because the posture is worse or the vibration is higher or the grip force is higher. External force alone doesn't tell you.



Corn

That's the deepest point in this whole episode, I think. The tool can be less forceful and more tiring at the same time.



Herman

And it directly undercuts the assumption Daniel is poking at. "The tool does the work" isn't wrong exactly, it's just incomplete. The tool does the work and then hands some of it back in a form the instruments weren't looking at.



Corn

Alright. He asked for a verdict on the workout question. Give it to him.



Herman

No study frames power tool use as a strength workout. I looked across muscle activity, energy expenditure, grip fatigue, machining force, and there's nothing. The literature consistently frames the physical load as an occupational hazard, not a training stimulus. And there's no metabolic or energy expenditure study of power tool use specifically. Nobody has measured the calories.



Corn

So the honest answer to "can a Dremel be a workout" is: it's physically demanding, and nobody has ever studied it as exercise.



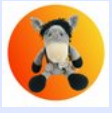
Herman

Correct. But here's the implicit proof, and it's the exoskeleton research. Xia and colleagues, Ergonomics, 2024. Overhead power tool posture is dominated by shoulder muscle activity. They put arm-supporting exoskeletons on people and measured.



Corn

And the exoskeletons worked.



Herman

The good ones reduced anterior deltoid and serratus anterior activity by twenty-seven to forty-three percent. And one of them, the ExoStrap, actually increased upper trapezius activity by twenty-three to thirty-eight percent. So even the fix has to be designed carefully.



Corn

Wait. The exoskeleton made one muscle work harder?



Herman

By thirty-eight percent, at the top end. You move the load off the shoulder and it shows up in the neck. There's no free lunch. You redistribute.



Corn

But the headline is that industry is buying shoulder-support hardware that removes a quarter to nearly half of the muscle activity in the shoulder. Nobody builds an exoskeleton for a task that isn't a muscular load.



Herman

That's the proof Daniel is looking for. The industry's own spending says tool use is real muscular work. They're just treating it as a cost to engineer away rather than a benefit to chase.



Corn

Which is the correct call, given what the injury data says. Walk me through that.



Herman

Stjernbrandt and colleagues, Occupational and Environmental Medicine, 2025. A cohort of two hundred and three thousand, eight hundred and sixty-six Swedish male construction workers, followed for nineteen years.



Corn

Nineteen years. That's a career.



Herman

A career. And they looked at surgically treated carpal tunnel syndrome. Upper extremity load carried a relative risk of two point six. Power grip, two point five. Handheld tool use, two point three. Hand-arm vibration, two point three.



Corn

So the guy who spends his life gripping a tool has roughly two and a half times the risk of needing surgery on his wrist.



Herman

Roughly. And it stacks. Those exposures overlap, so the person with all four is carrying all four risks. Then there's Landsbergis and colleagues, twenty twenty-one, three thousand nine hundred and ninety-five railroad workers. More than five point two years of full-time power tool use was associated with shoulder pain at two point zero one, elbow pain at two point eight eight, and hand and wrist pain at two point four.



Corn

The elbow is the worst one there. Nearly three times.



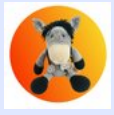
Herman

And there's a useful split in the biomechanics. Grip force is the primary contributor to tendon strain and wrist injuries. Push force is the contributor to shoulder injuries. So which part of you breaks depends on which part of the job you're doing.



Corn

Push hurts the shoulder, grip hurts the wrist. That's a clean way to think about it.



Herman

And for Daniel with a Dremel, he's doing both. Grip on the body of the tool, push to feed the cut. That's the wrist and the shoulder, in one afternoon.



Corn

Which loops us all the way back to the paradox. The tool exists to remove force from the human body, and the KTH thesis says the tool's forces can exceed what the operator can safely counteract. It creates a new physical demand at the same time it removes the old one.



Herman

That's the answer to "is it a workout." Yes, the load is real and measurable. And the entire literature treats it as a risk to be reduced, never as a stimulus to be sought.



Corn

The answer to Daniel is: you did a workout, and every researcher in the field would call it an injury exposure instead.



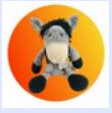
Herman

If it helps, the framing is his own fault for measuring the right thing. He noticed the sweat. The field measures the wrist.



Corn

A career's worth of wrists, in one number. Two point five times the risk of surgery.



Herman

Which is exactly what the sheet metal guy on the next shift would say, if anyone had asked him.



Corn

He never got asked. That's the whole point.



Herman

Look, they built a handle with strain gauges in it to prove he was squeezing. They just built it for the automakers.



Corn

The man in his garage with a Dremel and a stack of HDPE boxes is still holding the tool himself, with nothing supporting his arm, and no study with his name on it.



Herman

Which is where I'd leave it. The research says the load is real. It just never counted the hobbyist.



Hilbert

My brother-in-law did sheet metal for thirty-one years.



Hilbert

I'd go over on Saturdays when I was a kid, and there was one bench, the corner one by the window. He had this trick where he'd brace the die grinder against a bench dog before he started, so the first bite into the metal couldn't walk the tool across the panel. He'd set it against the dog, get his shoulder behind it, and then let it run.



Corn

He pre-loaded the tool before it ever touched the work.



Hilbert

He said you don't fight it after it bites. You decide before it bites. And he had a tin of something in the drawer, a liniment, and every Friday night he'd rub it into his right forearm and his hand. He kept a fresh tin in the drawer at all times. There were probably nine tins in that drawer when we cleared it out.



Corn

Nine tins.



Hilbert

He never threw one out. He'd just buy another. And he used two hands on the small grinders by the end, both hands on a tool you're supposed to hold with one, because his right grip wasn't what it was. He never said anything about it. You'd just watch him switch.



Herman

That's the experienced-user finding, right there, in a man with a drawer full of liniment. He compensated the way the experienced nutrunner operators did. He braced harder and used both hands to lock the tool down.



Hilbert

He did the same trick every time. Same stance, same bench, same hand. He said the metal always does the same thing. You just have to be the same every time.



Corn

It reads like he was managing a risk he couldn't name.



Hilbert

The doctors called it a nerve thing in his wrist. He called it "the grinder." He'd say the grinder's acting up today.



Herman

Twenty-three percent higher risk of surgical carpal tunnel for handheld tool use. Two point five for power grip.



Corn

That's a diagnosis. "The grinder" is what he called it.



Hilbert

He gave the tin to my nephew when he sold the shop. My nephew's a plumber. He's got it in his van.



Corn

Okay, that actually connects something for me. Herman, you said the experienced people brace harder and take more load in the muscle rather than letting the handle move. Now I understand why they'd choose that trade.



Herman

Say it.



Corn

Because the handle moving is the thing that hurts you long-term. They've learned that absorbing the motion is what ruins the wrist, so they voluntarily take more muscle load to keep the tool still. They're trading today's fatigue for tomorrow's function. And the man with nine tins of liniment is what that costs over thirty-one years.



Herman

The tins are the part the research can't give you. The studies say relative risk two point five and incidence rates per hundred thousand person-years. Nine tins in a drawer is what two point five looks like on a Saturday.



Corn

The numbers were always a person, just a very good compression of one.



Hilbert

The last tin, he'd marked. He wrote the month on the lid in marker. February, I think. He liked to know when one ran out.



Corn

I think that's the note to end the discussion on. Not the nine tins, the marker on the lid. He was tracking something.



Herman

He was tracking it.



Corn

The research tracks it too, nowadays. It tracks the joints. It just tracks them in a lab, and the man in the garage is still tracking his own forearm with a tin and a marker, and nobody's put an instrument on his handle yet.



Herman

That'll be his song. He thinks the whole field is aimed someplace else.



Corn

He's not wrong. It's aimed, and he's standing behind it.



Herman

There's one open question I want to leave on. The exoskeleton data is thirty percent reductions in muscle activity that are now being engineered into industrial work. That's the load being deleted.



Corn

In a factory, the paradox gets solved. The tool stops handing its force back. The person stops being part of the tool.



Herman

In a garage, you are still part of the tool. There's no exoskeleton for the home inventory system. There's no PCL for a Saturday afternoon with a Dremel and HDPE.



Corn

The future arrives unevenly, and the last person holding the reaction force is the hobbyist. And that's Daniel.



Herman

A quick thanks to our producer, Hilbert Flumingtop.



Corn

This has been My Weird Prompts. If you want to send us your own prompt, you can do it on Telegram at t dot me slash MWP listener bot.



Herman

We'll be back soon.



Corn

See you then.

SOURCES

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