



Education

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Using Basic Physics to Avoid Injuries

BY CECILY MORROW

Recently the competitive figure skating world has seen many skaters, including elite athletes, sustaining serious injuries, among them back and leg stress fractures. I believe it has to do with the drift in the last 13 years toward more rotation-based jumping, as opposed to distance-based jumping originally brought in by legendary coach, Gustave Lussi.

The buzz lately on YouTube is over two very young, foreign skaters, one landing a triple Axel, the other, multiple triple loops in sequence. While these young men are obviously capable athletes, at least one point bears questioning: Why are they performing jumps without much height or distance and with little actual flow into or out of the jumps upon landing? If you take away their speed over the ice, for example, as actually occurs in the final triple loop sequence, the jumps push straight up into the air, rapidly spin approximately a foot off the ice, and then land on the take-off spot.

Rotation jumps like this are being performed at every level in skating today. When shown footage of former skaters from the 1970's, 80's, and '90's performing triple Axels, etc., many skating enthusiasts comment on the terrific lift forward, the distance, height, and follow through of arms and free leg *before* rotation begins, the "air time" that most skaters used to achieve before rotating.

1962 World Champion Don Jackson, a student of Mr.

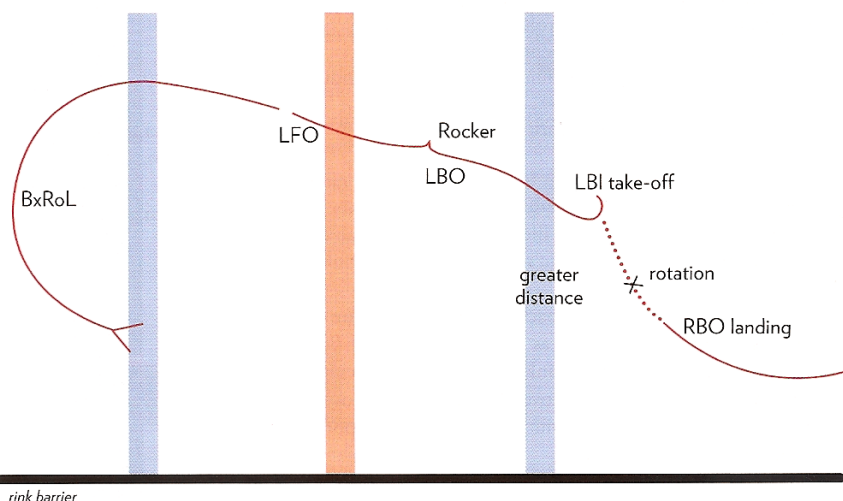
Lussi, in an interview for the PBS documentary, *Gustave Lussi: The Man Who Changed Skating*, said: "Every coach wants to get a nice lift before you rotate. And I think Gus Lussi, because of his technique of jumping and getting your free leg through and *then* turning into the back spin — that gave that feeling of almost a delay, or a lift and then a rotation. Whereas, sometimes you see skaters that are interested in rotating rather than getting up. And I remember Gus saying, 'Don, jump, and then turn. Jump, and then turn.' And that's what I try to get through to my skaters."

In the recent past, skaters learned to jump up and out first, to strive for distance and height before rotating; now, many skaters initiate rotation while jumping up, but only travel forward based on the amount of speed they have going into the jump. Take away the forward momentum over the ice from these rotational jumps and you are left with vertical, angularly torquing hops. The take-off and landings of these rotational jumps are putting much more torquing (twisting) stress on take-off legs, and torquing and pounding (gravitational) stress on the back and landing legs than if the jumps were performed at the same height or greater, *over a longer distance extending along a straighter trajectory*.

Since the late 1920's, Gustave Lussi and his innumerable champion students revolutionized figure skating with his relentless striving for more distance, more *flying* in jumps



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For the Salchow, Lussi recommended a delayed-rotation jump entry (against rotation direction)



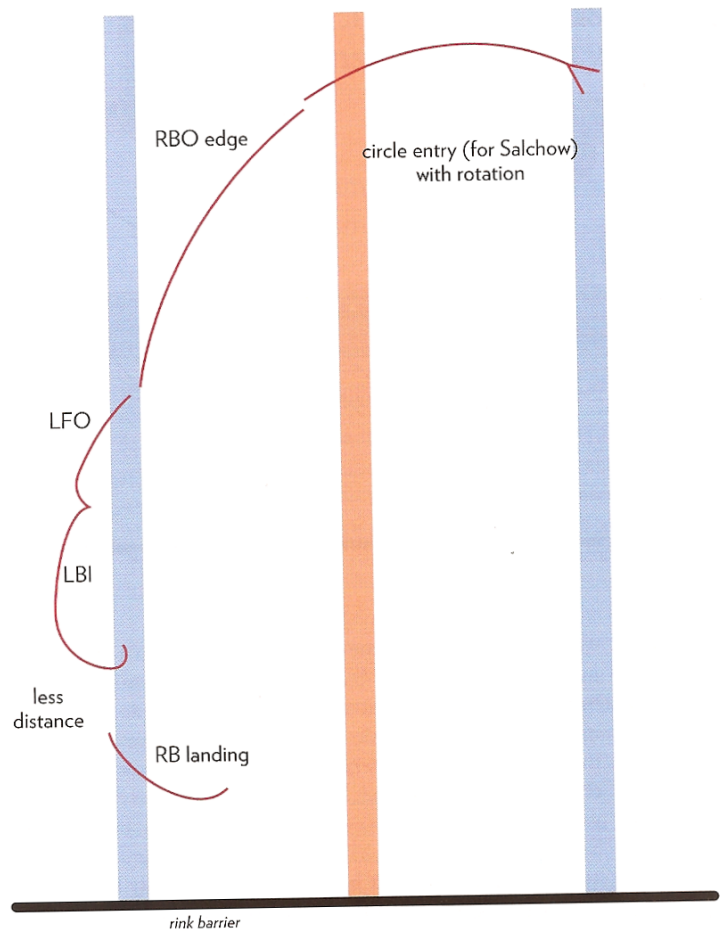
PATTERNS FROM OVERHEAD

and faster rotating spins. Specifically, Mr. Lussi would tell his students in lessons that he was not a fan of rotation jumps like Sonja Henie's that jumped on a curve. A ski jumper originally, Gus Lussi experienced the thrill and understood the freedom of shooting straight up and out over his skis, pushing and expanding his body to get the height and distance off the jump, that soaring feeling of jumping along straight lines; so, in skating, he borrowed from the more exciting aspects of the speed skaters and distance barrel jumpers like Axel Paulson.

Carlo Fassi, longtime coach of Olympic champions Peggy Fleming, John Curry, Dorothy Hamill, Robin Cousins, Scott Hamilton, and Jill Trenary, was a student of Gus Lussi in 1951, and brought all of his students to Lake Placid in the mid 1970's, including Dorothy Hamill (already a Lussi student), to train with Mr. Lussi for a year. He said: "Gus Lussi really changed the philosophy of skating. During the war, he has a chance to be in America; skating in Europe was stopped practically from 1939 to 1946 practically, and he was able to develop it there (in U.S.). ...He completely changed, technically, many things; he invented many things, the flying sit spin, the flying camel and he brought in the triple jumps. It definitely was a turning point from what skating was before the war, 1936, 37, when he came in 1946, 47, and when the pupil of Gus Lussi, especially Dick Button, came to Europe. It was really a different kind of skating. So, I think his teaching was extremely important. He really had the ability to explain it very simply, the mechanics of the jump. He was able to teach the different component of the jump."

By the 1950's Mr. Lussi's skaters were doing huge double jumps (Dick Button's Axel spanned an average of 19 feet) as well as the first triple jumps, including the triple Axel in 1956 (Ronnie Robertson). Ultimately, spanning the last half of his life until his death in 1993, Mr. Lussi used his decades of knowledge gained to invent and employ *delayed-rotation*, a technique focused on gaining the maximum distance and height possible, before rotating, in double and, then, triple jumps. When his students, as skaters and coaches, dominated the world figure skating scene until approximately 2002, there were far fewer injuries than we see today. And, although he disdained quadruple jumps because they limit the number of athletes who can participate in the sport at advanced levels, Mr. Lussi intended to apply the same delayed technique to quads.

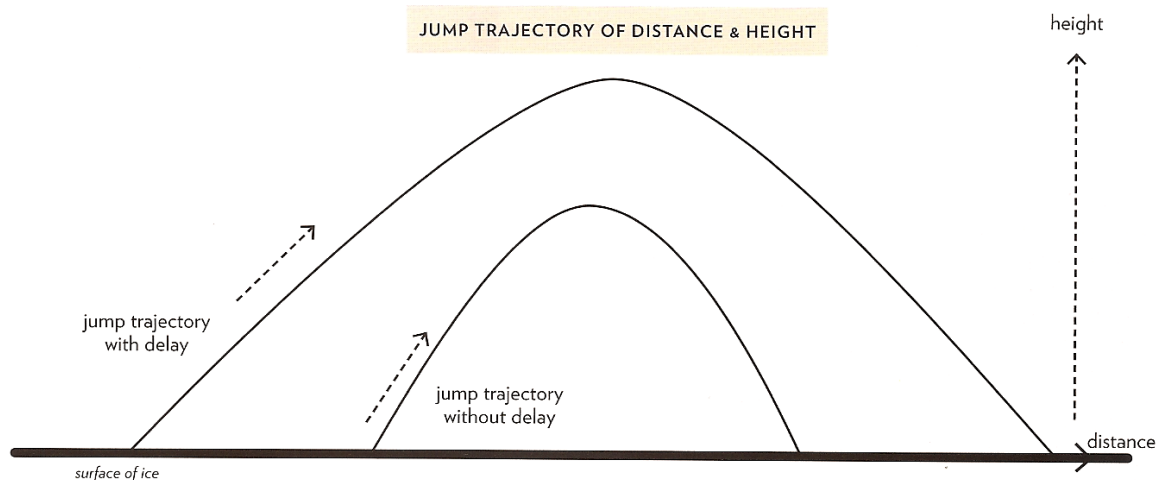
"There should always be a delay as you lift off the ice; you could hold that delay until you're at the peak. ...We generally worked on delayed doubles. That was the key. That's all part of controlling the rotational force. If you can do delayed doubles then you have a better chance of taking off the ice for a triple without rotating too early, because that will kill you on a triple." says former U.S. Olympic and



world competitor, John Misha Petkevich, arguably one of the biggest jumpers ever. "When you step on an edge, you're immediately creating angular momentum (rotation) and the whole body wants to turn in the direction of that edge. The faster you go, or the deeper the edge, the faster the body will want to move around. So the first thing is to stop the creation of that inherent angular momentum that the edge wants to exert on the rest of the body...Having the arms go straight out, leg passing straight through, never bent... You want to get the maximum force with that leg—upward motion, forward motion; if you keep it straight there's a lot more power behind it.

"My primary coach and I engaged Gus to be a technical advisor with respect to jumps and spins. ...Gus Lussi understood the fundamental physics of figure skating, and because he incorporated those physical laws, rotation, speed, force, the motion of mass, all those concepts, incorporated them into his techniques and harnessed physics to accomplish the jumps, his techniques will remain the foundation of figure skating forever. There is no way to get away from it because it's based on fundamental laws of physics. ...And I've never run into anyone who understood skating in that way."

Sadly for skaters and their audiences, upon Mr. Lussi's death, the older, rotation based jumping began slowly creeping back into the jumps of U.S. skaters. Carlo Fassi



was concerned about the focus on rotation in triple and quadruple jumps as far back as 1990 when he said: “We’ll have a performance that only *few* skaters can do, and the majority will not be able to do it; so we’ll have restricted the sport to very few, very young. ...We will not have the charisma of a champion like Katarina Witt stay for four years. We’ll have a new champion practically every year because those girls will have a very quick life as a skater—14, 15, 16, they will reach a peak—and probably before 19 they will be gone, because at that age it is quite difficult for a girl to have that rotation so quickly like the little ones. So, I think they should start to give more importance to the beauty and to the finish of the skating...”

Even though Mr. Lussi refined his methods to make huge, delayed-rotation triples, invented the crossed-leg rotation position, and had students doing triple jumps for fifty years, nevertheless, with his commanding presence and influence gone, rotation jumps edged back in with the resultant frequent and serious injuries we see today. In the words of two-time Olympic Champion Dick Button speaking several years ago: “I learned everything from Gustave Lussi. He was an influence that was the greatest in the sport. He had taught generations of people how to skate; he continued to teach generations of people. And he had a basic understanding of the way the body worked and the way it worked best in skating. And his technique at jumping and spinning was so great, and so wonderful that I just hate to see a lot of it lost today.”

Fortunately, a movement is afoot now to bring back delayed-rotation jumping and pure, fast spinning as necessary for the longevity, health, and enjoyment of our U.S. figure skaters, and similar to the resurgence of figures as a necessary component to developing the finest level of figure skating. Delayed jumps are actually easier to perform than jumps skated on a curve. Even younger and not strong skaters can do delayed jumps; Mr. Lussi’s method can be used to avoid stress fractures and other injuries in elite skaters. Canadian National competitor Rick

Boudreau learned the delayed rotation jumps specifically for demonstrating them in the video series, *Systematic Figure Skating: The Spin and Jump Techniques of Gustave Lussi*. He said recently: “When you think about it—how else can skating evolve? Delayed jumps make sense.” Boudreau grew up learning to jump on a curve but, after a few days in Lake Placid with me, he was able to master the delayed jumps. Two more weeks of instruction and he landed the delayed triples. The two methods are not so different; in fact, Boudreau was able to switch back and forth at will. Audiences love the high-flying delayed jumps, because they offer eye-opening athleticism plus beauty, flow.

Mr. Lussi’s delay of rotation allows the skater to travel forward outstretched in mid-air. This delay produces faster rotation in a shorter period of time at the apex of the jump due to the increased angular velocity generated by scissoring from the extended position in to Mr. Lussi’s rotation position.

Using his exact back scratch spin positioning to train the check-out timing, Mr. Lussi taught a skater to suspend the rotation, a second delay, on the end of big, multi-rotation jumps performed at top speed. The unhinging of the leg and opening the arms actually completes the last three quarters of the jump rotation, preparing the skater for a clean landing with increased speed. When the head spots and holds the landing location at three quarters of a rotation to go, he opens the arms, lifting the torso away from the ice, and unhinges the free leg to hold the feet side-by-side in reserve, so, at touchdown, he can pull the arms and body strongly up and back in the direction of travel, and flex then push, expanding both legs to create speed and outflow.

In contrast, a jumper who travels at speed over the ice on a gradual curve to take-off then initiates rotation upon ascent must fight the strong pull down and around of centripetal and gravitational forces from the moment he steps onto even a gently curving take-off, many times leading to revolving *around* an axis, not quite over one leg, resulting in a myriad of problems on the landing. Misha Petkevich describes the problem with learning jumps on a circle: “Let’s say you

are doing back crossovers counterclockwise, you're looking [over the right shoulder] because that's how you do them, now you're going to get ready to do an Axel, so you have to rotate the entire body in the direction in which the angular momentum is being created [to the left], and now you've got to stop it. That's hard. So Gus said: 'Let's do crossovers clockwise, the opposite way that we're going to create angular momentum on this jump.'"

The idea for the jump approach came to Mr. Lussi from studying speed skating. He elaborates: "A speed skater when you go straight ahead has no pull hardly at all. But when he comes to the roundness of the elbow on the end of it, there's where his stress comes greatest. Same as we do in the spiral, on a plain lousy spiral, in a circle, in a circle spiral. Why does the body become so heavy on a spiral? That your weight increases three-fold on a good spiral if you have speed. It pushes you down. It pulls your legs; it pulls your whole body down. And if you can weigh it underneath on a glass plate, you can see, if you come on it straight, straight line in a spiral, there's nothing. As soon as you start to turn in on it, the force holds us."

Mr. Lussi further notes that the speed skater who, crossing from the inside lane to the outside, has more difficulty getting into the curve because he is naturally propelled out on a tangent to the end curve, similar to the skater who, taking the jump entry in the opposite direction to the rotation direction, is easily propelled straight forward and up at take-off, the short, quick, expansion of the body projecting the skater farther forward and higher up than from a jump skated on a curve. Relying on timing and accuracy of position rather than strength, the skater jumping in a straight line over a greater distance with height will naturally diffuse the rotational twist on the legs and back as well as relieve the vertical landing pressure on the ankles, knees, legs, and back.

All coaches can quickly introduce Mr. Lussi's basic technique to their skaters: 1) Teach all levels of skaters to jump on straighter lines, employing a lifting action that produces maximum distance and height, maximum flight forward and upward, before rotation; 2) Teach all levels of skaters to pass the free leg and arms straight through in the direction of flight, expanding the body upon take-off, to counter-act or stop their rotation, single, double, triple, or quad, on the entry edge, take-off, and flight forward into the air; 3) Teach all levels of skaters to reverse, or scissor into rotation isolated at the apex of the jump; 4) Teach all levels of skaters to suspend, or delay, their rotation *at the exit of all jumps*, in the air, to prepare for a landing action; and, 5) Upon descent and touch-down, teach all levels of skaters to use core muscles to control the body as one unit, in one seamless motion, lifting the torso away from the ice, pulling up and back while flexing and expanding both legs into the direction of flight.

We have included a simple illustration of the concept that taking the jump counter to the eventual rotation direction, followed by a straightened take-off, launches the skater out farther and up higher into the air than a jump entered on a curve.

The human body that jumps—catches air—first, with maximum distance and height, can then isolate the rotation

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(angular momentum) in the apex of the jump, therefore relieving the torquing stress on the body at take-off and landing. Like a centered spin, a skater deftly controls the more isolated rotation than if it were spread over the whole distance of the jump like a traveling spin.

Similarly, the human body that jumps with maximum distance and height first, isolating the double, triple, or quadruple rotational force to the air-borne apex segment of the jump will be able to stop that rotation by spotting the landing line, in effect, stopping the head turning in the direction of rotation, opening the arms, and unhinging the crossed leg to hold beside the other in preparation to push out the landing, facilitated by the straighter, much less vertical touch-down and clean back outside edge.

Further, the human body that employs all of the above in jumping, having prepared for a straighter edged, diffused stress landing, can lift away and pull back on the torso as it gently flexes then expands both legs at the touchdown.

The skater who applies all of the above techniques originated by Mr. Lussi for jumping will measurably reduce falling and avoid leg and back stress fractures and many other stress and jumping-related injuries. Misha Petkevich: "It's a very simple reason why his skaters were so consistent...understanding the rotational forces that are created in skating and learning how to control those. ...Once you

knew what you were doing, you could take the [delayed] jump off any preparation." ❖



Cecily Morrow worked with Gustave Lussi extensively in the latter years of his life. She authorized the video series Systematic Figure Skating: The Spin and Jump Techniques of Gustave Lussi, of which Volume IV is now available (www.IceCommand.com) and documents his teaching methodology. Cecily conceived of,

and was Associate Producer of the PBS documentary Gustave Lussi: The Man Who Changed Skating. Her other video documentaries include Stoking Exercises on Ice: The Dance Training Methods of Natalia Dubova. Cecily has taught Mr. Lussi's techniques to coaches, judges, and all levels of skaters, including international competitors and Olympic champions. She served for several years on the PSA's Coaches Training Committee and the advisory board of Skater's Edge Magazine. She was a founding member and principal skater of the Ice Theatre of New York. She studied at Oxford University and holds a B.A. from Smith College. ❖