MENTORS IN ORTHOPEDICS

WAYNE PAPROSKY

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SUMMARY

Wayne Paprosky's trajectory from professional Canadian football to the forefront of reconstructive surgery reflects a career defined by technical adaptation. Initially drawn to cardiology, a series of clinical rotations redirected his focus toward the complexities of failed arthroplasty. His development of the definitive acetabular classification system emerged from managing high-volume trauma and revision cases. Today, he remains focused on the biomechanical relationship between the spine and pelvis, utilizing digital planning to refine surgical outcomes for future generations.

Wayne Paprosky is the Man behind the most used classification system of acetabular bone defects encountered during total hip replacement revision surgery. Honored Special guest at the last French Academy Convention in Paris, Wayne Paprosky accepted to share his experience and vision with Maitrise Orthopedique.

Where are you practicing today?

> I practice at Rush University Medical Center in Chicago. Half of the time I am at Rush and half in a private hospital outside of Rush University. My practice exclusively deals with arthroplasty of the knee or arthroplasty of the hip and of that, about 25% - 30% are revision surgeries.

What are the differences between the hospital practice and private practice, besides surgical fees issues?

> In the US there are no surgical fees issues. Insurance third-party payers such as Blue Cross or Medicare pay the same fees whether you are a private hospital, a university hospital, or a purely government sponsored hospital. The main difference is that the private hospital tends to be a little more efficient, things can get done more quickly, but there is not an extreme difference. I have to add though that my practice at the private hospital is a tertiary care center, so it's similar to a university hospital: we are able to do the same complexity of joint replacement cases there, mostly because, about thirty years ago, I began developing that hospital into a subspecialty hospital for hip, in the arthroplasty specialty divisions.

So why would people want to go to a private hospital?

> It's not as big, it is less crowded because it's not in the city, and you get a little more personal attention. But one is not any more competent than the other with respect to arthroplasty. For certain kinds of special tumors, such as rare liver tumors, then the university hospital is better. But it's becoming more common in the US for certain private hospitals to be very subspecialized in joint replacement.

How many cases do you do in the morning in your private practice and in your public hospital ?

> Actually, in my hospital, there is not that much difference. In our university hospital, which is a relatively new facility, the only procedures performed in my section of the university hospital are

spine and arthroplasty. So I can usually be as efficient as I am in the private hospital and there is not that much difference. So, for example, I can get eight primary surgeries done in either hospital by about 3 o'clock.

How do you do that ?

I run two rooms, but they are staggered. So, for example, one begins at 7 am, the second room begins at maybe 8 am and the fellows open and close. It's very strict. You must be there for every part of the operation except the opening and closing. That's the law. So, it's a pretty finely tuned machine but once you tune it, it's very, very efficient.

Are both centers training institutions ?

Yes, they have fellows, post-residency people. They are granted privileges because they are already qualified orthopaedic surgeons who are taking an additional year of advanced training. In both institutions we have residents, as well as fellows. However my fellows follow me from the private hospital to the university hospital. Residents generally are not allowed to perform unsupervised surgical procedures.

Could you retrace the genesis of your classification system ?

It all started when I was at Loyola University . Loyola is a teaching surgical facility located in a Chicago suburb, Maywood, approximately ten miles from the big city center. I was immediately extremely busy because we also had, in the system, a veterans' hospital. Most of the surgery was done by the residents at the veterans' hospital and was not well supervised. There were many failures, from these unsupervised cases, so within the first two to three years I did 300 hip revisions. Somewhere around my first year there, I met Dr. Charles Engh's team who had developed one of the first cementless stems and they were just using it in primary surgery. I told him I thought this might work in revisions. I had tried a few cemented revisions but they were not working, so they manufactured some special longer prostheses and I started to do cementless revisions in the veterans' hospital. All of a sudden, within two or three years, somebody from Charles Engh'steam was organizing a course and he asked me if I wanted to participate. I remember presenting at a small course in Chicago and there were Charlie Engh, Emmett Lunsford and David Hungerford among others, who wanted me to come on the circuit. It all began because I did all those cases and Charlie Engh introduced me.

How was this cementless stems strategy working ?

At that time, in revision cases, I was removing cement with a hammer and a chisel and inevitably,I was making some holes in the femur; we had to mend them and try to keep the mended section smaller to make sure it remained tight. But sometimes the stem was too long, it broke through the hole, and then we couldn't get the stem out, so we just cut the end of the stem off and it worked. When I saw some of these big holes, I thought let's make cat scan based strut grafts, and we got cadaver strut grafts and put wires around them and the bone incorporated. But the main philosophy was to get that stem down distally in good bone, bang it in, and if it was stable there and didn't rotate, we assumed bony ingrowth would be facilitated.

How did you confirm you had got something working?

It took us one or two years follow up, for the first time, to realize, to our surprise, that the bone grew in to the implant. Cementless femoral revisions appeared valid. We were in fact treating a

> veteran population. The population subset of veterans was obviously male and maybe 45 to 50 years old.

Was it then that you came up with your classification?

> No, not yet. Now, we had to figure out the socket. We were cementing the socket in and that didn't work. We packed the defects with some mesh, some bone graft, or additional cement. The stem was holding but the sockets were not doing so well. At that time, few cementless cups were available and they did not have holes for screws. We requested designs allowing screw fixation, because at that time, Charlie Engh was using a cup with no screws, but it had spikes. That was O.K. for primaries but not for revisions, because they required larger diameters. The acetabulum was the most difficult to figure out. I did most of the pelvic trauma at Loyola and a lot of acetabulum fractures at Henry Ford. I developed this pretty much on my own. I learned the procedures and went to several AO courses and became a good fracture technician, but that's where I really understood acetabular anatomy. My pelvic trauma experience enabled me to develop the acetabular classification around the migration and Kohler's line as I observed these defects in the acetabulum. It was based on the requirements to stabilize the component, that's how I developed the classification system. The radiographic analysis came later. The rationalization was a work in progress:up and in, up and out, Kohler's line. The acquired knowledge from pelvic trauma experience allowed us to link what would be normal with what was missing at revision. It happened before CT scans came up with the idea of reconstruction algorithms.

When did you publish your first paper about these classifications?

> The very first time that I introduced the acetabular classification was at a scientific exhibition for AAOS at the 1989 academy. I remember it because I kept my pager with me at all times, my wife was late to deliver one of our children and I had to be reachable while attending that big exhibit. The femoral classification, in fact, came a little bit later, but this was a little bit easier because it was just based on the amount of diaphysis available.

You must have had many academic contacts because your classification was betteraccepted than the AAOS one prevailing at that time ?

> Yes, in fact no one understood the early AAOS classification and I still don't understand this classification since it was not treatment oriented. It was based more on reconstruction with cement, cages and things like that. Mine was purely based on how I thought revisions should be done without cement. Surgeons who didn't believe in cementless surgery for revision didn't accept the classification. David Hungerford made note of my exhibit and was the first person who promoted my classification. He invited me to the first American Hip &Knee Society meeting and that's when we went over it. I remember at this academy, all the famous surgeons, such as William Harris and Jorge Galante, were interested and came around asking questions. I was maybe 37 I just thought that it was a good idea to keep researching on this subject.

Are you a pure cementless believer for the knee too?

> My primary knees are 100% cemented, except for my revisions where I use Trabecular metal cones, but my hips are 100% cementless. I haven't put cement in hips for 25 years now.

How was your thinking evolution in big bone loss management ? Did you use huge allografts ?

> Yes, we could fix a huge allograft with a plate. But some of them fractured, so we had the good idea of protecting it with a Burch-Schneider cage – small and large - and that worked better, but we had to prepare the graft, plate, cage; when we first published that, the results were OK but then in subsequent follow-up, some of those grafts resorbed and failed. But these were in the severe defects with no support. If there was partial support, like a 3 A, a bulk allograft worked very well, as initial partial support. As you probably know, the 3 A has slightly less that 50% bone support with some supero-lateral migration. We just published 25-year data on that. So by now, I was seeing the definite subdivision of different specific defects; what worked, what didn't work. By the time those allografts failed, after about 8 to 10 years, Trabecular metal became available. I was very lucky in some of these failures since the grafts had incorporated. So, by then that part had evolved. I was a step ahead of the curve, so I was able to continue to think about it.

Since when have you been usingtrabecular metal?

> The first time was in 1999 or 2000. My paper at the French SoFCOT Convention reported our data on pelvic discontinuities after thirteen years, but in fact, I had started to use it in 1999.

What happened next when you became kind of famous after the classification? Did that change your practice ?

> Yes, I got all these horrible referrals. It was terrible, the worst mistake in my life: to be well known. They started sending people from all over. Unfortunately, my practice became 80% revisions. The good thing was I got a lot of data, and continued many publications but I thought it was crazy not to do more primary surgery. The highest amount of surgery was probably when I just did so many revisions, maybe from about 1992 to 2006. After that I realized the need to reassess. Then we started to bring in a couple of younger guys that we trained and I was doing maybe only 25 to 30 % revisions.

You couldn't do eight cases a day anymore?

> I couldn't do 8 revisions a day. I was doing about 6 or 7 revisions a week. At the same time, we also discovered on the femoral side that the big stems didn't work if the diaphysis was less than 4 cm lengthwise or greater than 18 mm in diameter. That was a very important discovery. We first published that in 1997 and it changed our procedures. Everybody was using fully coated stems and when we noticed that there were a subsection of patients, that's when we got permission to use Wagner's taper. I had met Wagner and I saw some of his results. His first prosthesis was somehow a bit primitive but his taper was a good idea. I got special permission to use the link in those cases where we had previous failures of porous stems, that brought tapers stems to the US. We published 5 or 6 cases and this changed all our thinking for the difficult cases.

Any comment about corrosion?

> We haven't seen any corrosion yet with the Link nor with the ZMR prosthesis.

Why do you get corrosion at the level of the femoral neck?

> That would take me three hours to explain. Companies changed the tapers, so now we use ceramic heads for everyone.

So if the taper works, you don't need to lock the stem?

> We never lock the stem with screws, as I believe you do in France.

When the load of revision cases skyrocketed, didn't you say you changed hospitals after that?

> Dr. Jorge Galante asked me to leave Loyola and come to join him at Rush in 1993. At that time, arthroplasty was at a high standard of training at Rush for residents and fellows. They were still doing cemented revisions and Zimmer had that fiber metal stuff under way. After about two years, Dr. Galante says: "You are changing the way we are thinking. I should never have brought you here." He was obviously joking. Going to Rush, in fact, opened up more doors for me.

Were you still doing knees there?

> I was doing lots of knee surgery but nobody cared. Everybody just thought I did only one operation: hip revisions. And they were surprised when I would do primaries. Nobody was interested in any of my thoughts on knees until about 10 years ago, when I started developing a revision knee system, but that's something else.

Can we say that in last 20 years, basically you didn't change your way of doing hip surgery, because you were right from the beginning?

> I developed the extended trochanteric osteotomy and did the first publication on this, I think in 1995. I was actually treating a periprosthetic fracture around a cemented stem and I was having trouble getting the stem out of the top part because of the cement. When I was trying to hit it out, the top of the femur opened up, and it was easy to get the cement out. I thought the next time I do a case, I am going to open the femur since the bone up there is poor anyway and my fixation is distal; so I used a postero-lateral approach when I opened it up and then I cabled it together. The next year we had an academy exhibition about Proximal Femoral osteotomy. One of my friends said; «That's not very descriptive. I have looked at your video, and all you've done is extend the Charnley's greater trochanter split. So why don't you call it Extended Trochanteric Osteotomy.» The first publication in the journal of arthroplasty was in 1998 and titled Proximal Femoral Osteotomy. What changed the revision perspective was the implant selection and the conversion from allografts to cages and later to Trabecular metal. The latest development was dealing with pelvic discontinuity with the distraction technique and that has now become very popular. I consider myself lucky, since most of these crazy ideas I had eventually worked.

There is a trend now a days to do anterior approach. Is that done in revisions?

> No, not in revisions. Even the lateral approach for revisions is difficult to do the acetabulum; I prefer the posterior approach, the direct anterior is not extensile. So, it's a bad idea for revision surgery.

Is there any important detail we didn't discuss about technique?

> I think I pretty much told you everything, but in my opinion the biggest advancement in orthopaedic joint replacement revision has been the use of Trabecular metal for acetabular reconstructions.

Where did it come from ?

> From a little company called Implex in New Jersey and that metal was used in manufacturing radar equipment. It's like a strong mesh, very porous, very rough.

Who had the idea of using this metal for the hip?

> There was a company called Osteonics, formed by Robert G. Averill, Robert C. Cohen and another guy, later bought by Stryker. They sold it and then formed Implex. Implex was in New Jersey and they got hold of this material and made a model block socket. They then showed it to Thomas Sculco at HSS. He put a bunch of them in and loved it.

At the beginning it was more to coat a ship than to fill voids?

> Oh, for sure.Then I think somehow David G. Lewallen from Mayo Clinic and Arlen D. Hanssen saw this and thought this would be good for revisions. So those two guys came to talk to me and Allan Gross from Toronto said let's form a group of people using this material.

Did Alan Gross use it for tumors?

> A little bit for tumors, but Alan Gross also did a lot of revisions. The four of us got together with Robert Cohen from Implex and started to make these pieces. We also did some cadaver work and started to use this for the voids. I was with DePuy at that time. Zimmer saw this because Lewallen, Gross and Hansen were with Zimmer, and then Zimmer bought the company. Then because of Trabecular metal, I left DePuy and went to Zimmer in about 1993. That's how that group of four of us developed the whole Trabecular metal system.

What is your biomechanic thinking of pelvis, generally ?

> I think the biggest problem with the pelvis now is that after spinal surgery some impingement occurs that leads to dislocations. We formed a company called Intellijoint which, in preoperative planning, can predict anteversion, leg length and offset and we are trying to combine this with the EOS technology to be able to exactly target the position in relation to the pelvis. I have a new interest in the pelvis now.

Dubousset thinks it's an additional spine bone, the lowest vertebra.

> That's exactly how I would put it, but I didn't verbalize it that way. 95% of the dislocations occur in people with spinal pathology, mostly from fusions or severe spondylosisthesis. It's because of impingement that the acetabular component is required to be in a different position; to prevent this impingement to occur, the pelvis acting just like another vertebra, the acetabular component repositions itself. It's the number one reason for dislocation. We are trying to figure that out with all those young computer experts.

What do you think about the Kerboull plate?

> Kerboull is very smart. I used to love the course that he used to put on at the Meridien Hotel, St Jacques in Paris. We became good friends with Marcel and we talked a lot.

Did you use his device for reconstruction?

> No, it was not approved in the US, so I had to use a Burch-Schneider, but Kerboull in my opinion was the first guy to really understand that you needed to use something like a snow shoe and I learned a lot from him. He made a very important contribution to the next step; a good breakthrough because without that type of cage, relying only on impacted grafting of these big defects, I don't know what would have happened.

A substantial part of your career was in Chicago; were you trained in Chicago ?

> No, I had an engineering type of background in Canada, then I went to medical school in Canada, but my specialty training in orthopaedic surgery was at Henry Ford in Detroit, Michigan and my fellowship in arthroplasty was at New England Baptist Hospital in Boston.

That means that initially you were living in Canada ?

> I was born in Canada, I am still Canadian. I have a green card, my wife is American, my children are American, but I am still Canadian.

Where and when were you born ?

> I was born in 1952 in Windsor, Ontario, which is next door to Detroit.

But you could have done a nice practice in Canada, couldn't you?

> After medical school, I wanted to learn where the big volume trauma was because I didn't know what I wanted to do after an internship in general surgery. The best place to learn trauma is in the big inner cities in the US. There, one can find any kind of trauma you imagine in the world; and also being from near the border, it was easy for me to live in Canada, eventually crossing the border every day and my plan was to go back to Canada, to Windsor, and just do general orthopaedics. That was my original thought. I did not initially intend to stay in the US.

So, your first move was to Detroit ?

> Yes, I just crossed the river every day. At that time, Detroit was a big motor city and a big trauma city. They called it "the knife and gun club".

Who were your bosses then ?

> The biggest guy who was a big influence to me was Alvin H. Crawford, a famous pediatric orthopaedic surgeon in Cincinnati. The chairman was Ed Gyse, a famous guy from Boston and also a sports guy. We had a relationship with the university in Ann Arbor, Michigan. So, we would go to Ann Arbor for academic things, and to Detroit for trauma. Then all that happened to me occurred by accident, in such a way I ended up in Detroit. Actually after medical school I wanted to be a cardiologist. So, my first year was in internal medicine but after six months I thought this was not for me. So then, in about 1977, I did a surgical rotation and I was supposed to be in general surgery, but they had too many guys in there, so the chief said: "You go to orthopaedics". I told him I didn't want to do orthopaedics. But he said: "Too bad, you go. We had a guy who dropped out of our program, so why don't you come". Well I said, I don't know , maybe, but I want to go back to Canada . That's Ok, he said: "We train Canadians, so you think about it". I thought about it and plus I was already thinking about getting a green card, which was difficult then, except if you were a refugee...So all of a sudden I was in orthopaedics. Some guy said "we like you

> and you have good hands", and there was a heavy sports program. They were taking care of professional teams, and I actually had played professional Canadian football. So, near the end of my four-year program which I liked very much, they asked me what I wanted to do. I told them I wanted to do hand surgery because in Detroit there were many injuries from the auto factories. So, I got accepted to a hand program but then my visa expired, and they said I couldn't work there any longer. My chairman said that if I went to Boston they could get me a visa extension. And I asked him "what am I going to do in Boston?" He told me to go and do joint replacements and that they would perhaps offer me a job, back in Detroit, and I could finally get a green card. So, I went to Boston. Everything happened by accident so far.

How long did it take you to adjust to the Boston knee and hip program?

> I adjusted pretty quick and I just loved to operate. By now, after my residency, they said I was knife happy. I stayed in Boston for a one-year fellowship. I was supposed to go back to Detroit but then I was offered a job at Loyola University in the Chicago area, as they needed someone to do revision surgery. At that time Boston was probably the first real hip revision fellowship.