OSSEOINTEGRATION: NEW DEVELOPMENTS IN SURGERY FOR AMPUTEES

PHYSIOTHERAPIST - ANDY STRANG

By Andy Strang BPhty, PGCertHealSci (Clin rehab)

Andy Strang graduated from Otago in 2002. He has ten years of experience in physiotherapy and has been working with Amputees on and off since his first position on ward 1A at Princes Margaret Hospital in Christchurch as a new graduate. He has been working over the past year with the Osseointegration clients that he will discuss for us and among other interests has spent time working with rock climbers, travelling to Sydney with the New Zealand sport climbing team for the World Champs in 2010.

What's your physiotherapy background Andy?

Well, let's consider this discussion more about the working athlete, rather than the traditional type of athlete that is of interest to most sports physios. Major achievements for me are working alongside people who are simply getting back on their feet again. When I started 10 years ago I was working with elderly clients who had lost a limb from peripheral vascular disease and might be lucky to return home. More recently I have been working with people who lost their limbs in the Canterbury Earthquakes and are rebuilding and redefining their lives.

Recently there has been a groundswell of interest in a procedure called Osseointegration. The catalyst for this was when TV3 screened a feature on a Nelson amputee undergoing a relatively unknown technique in April 2012. He had to travel to Australia to have this surgery completed. In Australia there are not one but two different surgical methods offered. Rather than using a traditional socket prosthesis, a metal implant is surgically implanted and the body is then given time to "osseointegrate" to form a direct bond between implant and bone. There is an abutment protruding from a stoma at the distal end of the stump and the leg is attached directly to the abutment. It's an exciting time as there is the possibility of this surgery being performed by NZ surgeons for the first time this year.

There are four amputees from New Zealand who have had this procedure performed in Australia and both methods have been used: the original Swedish method and a more modern German method. The original Swedish procedure is called Osseointegrated Prostheses for the Rehabilitation of Amputees (OPRA). The Osseointegration process was discovered in 1952 by Per-Ingvar Brånemark of Sweden inadvertently following experiments on rabbits. The method in its current form has

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been used in Sweden, the UK, Hungary, France and Spain. The German Procedure is known as the Integral Leg Prosthesis (ILP) method and is offered in Germany and Australia. The OPRA method is a threaded rod that is screwed into a tapped femur. The ILP procedure is a bang-in method that is very similar to modern hip replacement techniques and with similar technology.

How did you become involved in your current role?

My role with Osseointegrated patients really happened largely by chance. I was working within a large multidisciplinary team and we had the resources to manage complex patients. All of a sudden there were young, relatively fit and healthy people who had lost one or both of their lower limbs in the Canterbury earthquakes. I had some experience working with amputees and a team was cobbled together to manage their rehabilitation. Initially the prostheses that we were using were the traditional Ischial containment socket (ICS) type prosthesis with silicone liners. We started on a "stumpy" which is a fixed pylon prosthesis and very short. As balance and strength build you add height to the pylon and then finally when there is enough height then a knee can be added. Following the TV3 feature, a client became interested in the procedure and opted to have it done on both legs. Things happened very quickly and now we are about 8 months down the track since the first procedure was completed. If I was completely honest, ACC contracts had a lot to do with it as well and other very experienced clinicians were sidelined with politics. I have been very fortunate and grateful to have their assistance along the way. My role is developing at present and we are learning a lot both from our own experiences and from the teams in Australia. In particular Cathy Howells and Sarah Benson, both Physiotherapists in Sydney have been a massive resource and local support has been from Jetje Bullion at the ALC in Christchurch.

Can you describe your role with your team/clients?

I am a small player in a big team. There is the client, their family, surgeon, prosthetist, OT, seating specialist, nurse, GP, psychologist, anaesthetist, pain management physician..... You get the point.

My role is to gauge a person's overall fitness and capability as an amputee, strengthen muscle, reduce or prevent contractures, assess and train balance and proprioception, manage pain issues. I liaise closely with the prosthetist and often attend prosthetic fittings and adjustments. As I see clients regularly, often I might pick up on infection issues, medication problems, mood changes, sleep issues etc so a lot of my time is spent talking with the client and liaising with other clinicians that might be able to better deal with those things that crop up.

What are your specific tasks/responsibilities?

This is an interesting and developing area. The past few months have been a frantic period of information gathering and learning from overseas experience. My first role was actually to prepare a client for the Australian team in Sydney currently performing a version of the German ILP method of this surgery. A key area was the reduction of hip flexor contractures and core strengthening. Cardiovascular fitness on circuit training machines was used to help reduce BMI. Essentially you want the client to be in the best shape of their life – given the circumstances – before the surgery. I have been lucky to work with very motivated clients and a lot of the drive has come from them. Maybe my role is to focus the energy that they have on the areas that need the most attention and give them the tools they need to manage the process independently as well away from the clinic environment.

We are currently working on post surgical protocols. It really depends a lot on the surgical method as the two methods have vastly different timeframes associated with them. The OPRA method you are looking at 6 months or more until full weight bearing. The ILP method is closer to 2 months until full weight bearing. It is likely that a version of the faster and more modern ILP method will be used in New Zealand initially. I will be involved in pre surgical conditioning, following loading protocols to safely begin weight bearing through the implant, and developing cardiovascular, core and upper limb strengthening programmes. The loading protocols are very strict as you must not overload the implant. You start with a short peg leg attachment and load through a scale. We will start at 20kg of load 30 minutes twice daily. If all goes well you can add up to 5kg of load per day until 50% of body weight is registered on the scale. It will then be time for gait training in the parallel bars which will include learning about a new knee and foot set up.

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Osseointegration: new developments in surgery for amputees continued…..

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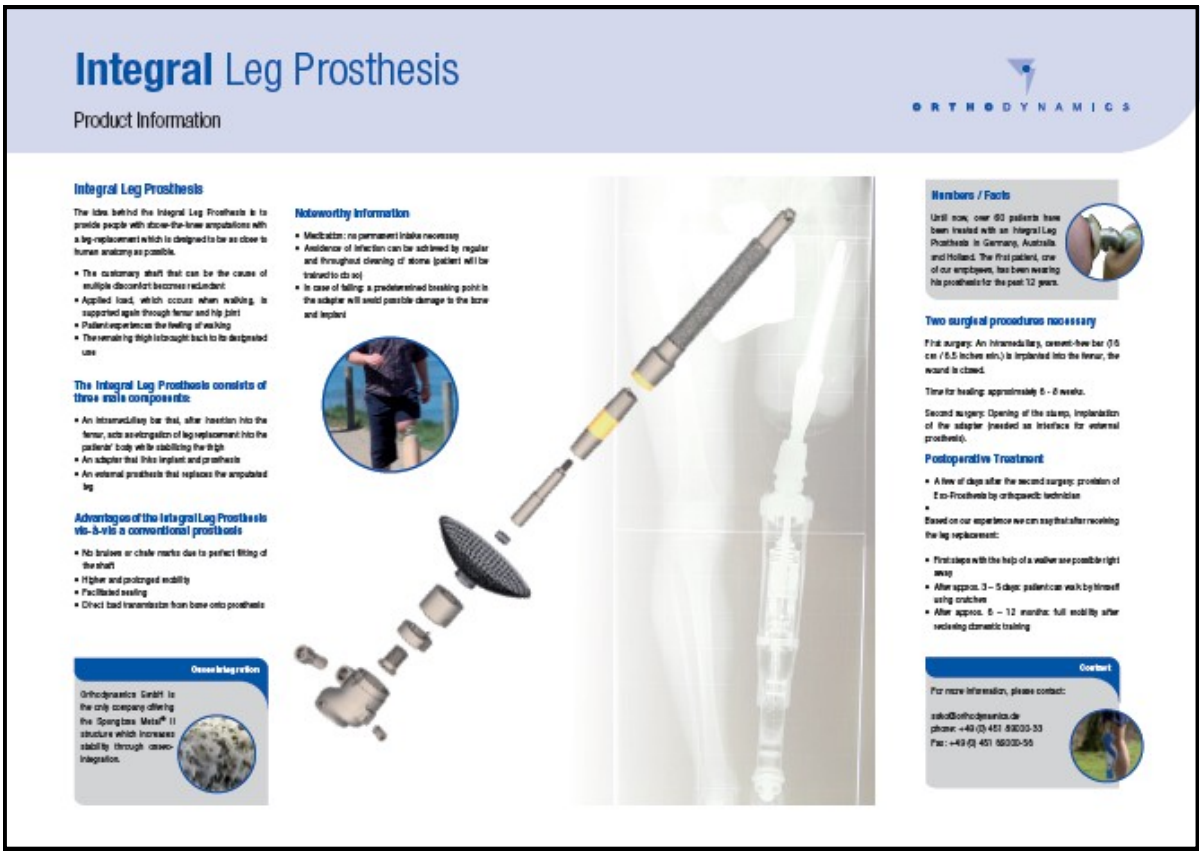

Integral Leg Prosthesis

Product Information

ORTHODYNAMICS

Integral Leg Prosthesis

The idea behind the Integral Leg Prosthesis is to provide people with above-the-knee amputations with a leg-replacement which is designed to be as close to human anatomy as possible.

- The customary shaft that can be the cause of multiple discomfort becomes redundant
- Applied load, which occurs when walking, is supported again through femur and hip joint
- Patient experiences the feeling of walking
- The remaining thigh is brought back to its designated use

The Integral Leg Prosthesis consists of three main components:

- An intramedullary bar that, after insertion into the femur, acts as a integration of leg replacement into the patients' body while stabilizing the thigh
- An adapter that links implant and prosthesis
- An external prosthesis that replaces the amputated leg

Advantages of the Integral Leg Prosthesis vis-à-vis a conventional prosthesis

- No bruises or chafe marks due to perfect fitting of the shaft
- Higher and prolonged mobility
- Facilitated sealing
- Direct load transmission from bone onto prosthesis

Osseointegration

Orthodynamics GmbH is the only company offering the Spongiosa Metal® II structure which increases stability through osseo-integration.

Noteworthy Information

- Medication: no permanent intake necessary
- Avoidance of infection can be achieved by regular and throughout cleaning of stoma (patient will be trained to do so)
- In case of falling: a predetermined breaking point in the adapter will avoid possible damage to the bone and implant

Numbers / Facts

Until now, over 60 patients have been treated with an Integral Leg Prosthesis in Germany, Australia and Holland. The first patient, one of our employees, has been wearing his prosthesis for the past 12 years.

Two surgical procedures necessary

First surgery: An intramedullary, cement-free bar (16 cm / 6.5 inches etc.) is implanted into the femur, the wound is closed.

Time for healing: approximately 6 - 8 weeks.

Second surgery: Opening of the stump, implantation of the adapter (needed as interface for external prosthesis).

Postoperative Treatment

- A few of days after the second surgery: provision of Exo-Prosthesis by orthopaedic technician
-
Based on our experience we can say that after receiving the leg replacement:

- First steps with the help of a walker are possible right away
- After approx. 3 – 5 days: patient can walk by himself using crutches
- After approx. 6 – 12 months: full mobility after receiving domestic training

Contact

For more information, please contact:

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Green Prescriptions continued…..

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What are the common client issues you are dealing with?

The above knee amputee who has sufficient femur residuum length is the most likely type of amputee to have this operation. At last count there were 26 amputees who had undergone the ILP procedure in Australia. Four New Zealanders have had the procedure, three of them with the ILP method. The cause of amputation is most likely to be from trauma, followed by cancer. The technique can also be used on trans-tibial amputees and also in the arm but is not commonly done internationally. It is not necessarily for high functioning amputees either as very low K level (scale which describes amputee function) amputees actually have the most to gain. The Australian experience has been very positive in this regard with K0 to K2 users shifting up to K1 to K3 levels following the surgery. K3 and K4 users are already functioning quite highly and might notice other benefits such as improved comfort from not wearing their socket prosthesis, better temperature management from allowing the skin in the thigh to breathe, less skin infection or abrasion.

With short residuum lengths there is the possibility of undergoing leg lengthening prior to Osseointegration. The leg lengthening is used to add sufficient length to a short femur for the implant to be able to fit. This process is being discussed at present as a way of increasing femur leverage. Short stumps have the added problem of lacking good distal muscle attachments and it may still be very difficult to get good control of the limb. Watch this space!

What do you think are the key elements in successful outcomes for your clients?

Client selection has been a recurring theme in the international experience as the first step in a successful outcome. There are no well defined criteria and each team working with these clients has a different opinion. This also makes it hard to compare surgical methods and "success rates" as one team may be willing to take a risk on a client where another team with an inferior technique is extremely conservative with client selection, and might get a better outcome on paper. Which team is doing better?

Pain management is critical and having experienced pain management physicians and anaesthetist in the team is a must. Having knowledge of non-pharmacological management techniques is just as important and often the clients will come up with novel ways of managing pain, both acute and persistent. The pain management strategies developed by the NOI group (Sydney, Australia) are constantly developing and are applicable to amputees.

Building trust, both in the prosthetic components, and also with the challenges that you present to the clients. The new Genium knee from Otto Bock is a major development, and provides a level of safety and confidence not seen in previous knee joints. We are currently managing the first client in New Zealand to be using this knee and there are likely to be other amputees who will benefit. The knee has a microprocessor that is responding to input from accelerometers and a gyroscope within the knee. It responds by changing hydraulic resistance within the knee to facilitate the desired movement or to resist knee collapse in a stumble situation. It's fantastic to watch a knee move so naturally and to observe the increase in confidence that this offers. It even allows for a natural loading response with a 4 degree flexion on heel strike which can be unnerving for users initially as this would have indicated a collapse with their previous knee.

Being patient and having a long term view. There have been as many setbacks as there have been gains and you have to try and take a step back and look at the big picture. Getting caught up in day to day issues means you often lose sight of the big goals. Being a full time prosthetic user is a big ask for a bilateral above knee amputee and accepting that there are limitations

The main team is the surgeon, anaesthetist and nursing staff initially. This is then broadened to include the prosthetist, physio, OT and psychologist.

How do you integrate/work with the team with respect to injury prevention or rehabilitation?

We spend a lot of time on email and on the phone discussing problems as they arise. As we are developing our knowledge the more we communicate about an issue the better. In an ideal world there would be a dedicated facility where everyone is on site but this is not feasible with the small number of clients that are being managed at present.

Are you involved in performance aspects for your clients?

I hope I haven't excited too many physiotherapists who are working with amputee athletes.... Osseointegration

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Green Prescriptions continued…..

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patients can't run! At this point there are no track athletes using this method as the implants and interface are not yet strong enough to cope with the huge loads although this is clearly an area for future development. Limb suspension and component strength is a major issue for athletes and you hear stories of sprinters going through tens of thousands of dollars worth of components in the search for something that will handle the load. David Howells, an Australian Prosthetist working with sprinters once told me a story about an athlete he was working with. The guy destroyed eight knees, some of them only lasting a few seconds before exploding on the track, until settling on something that would last. It's much easier to replace an exoskeletal component than it is to replace an Osseointegration implant, or to wait while fractured bone heals.

The energy consumption of an amputee is much higher than that of an able bodied person given the same task. For a bilateral above knee amputee, walking is estimated at between 200 and 300% higher energy consumption than an able bodied walker. We recently completed a 6minute walk test for a bilateral above knee osseointegrated amputee and achieved 280 metres, the equivalent of 2.8 km/hr. This is double the pre op score, but still less than an age equivalent able bodied person. Everyday living is performance activity and optimum conditioning is necessary just to complete ADL's, go to work and enjoy a social life. One client has taken up hand cycling and is looking at competing in the New York marathon in November this year. So although the Osseointegration is not going to help on the hand cycle there are still a number of performance issues that are managed alongside this process.

What are the major challenges in your work?

The biggest challenges are probably still to come. We are gearing up to start managing clients to have this surgery in New Zealand and a lot of work has, and still needs to be done. Besides the obvious challenges of the surgery and recovery itself, there are cost and funding issues (the procedure is likely to cost around $80,000 per implant), and that is not including the Genium knee which is a further $90,000 per knee. Add in a foot, the cost of fitting and adjustment and the rehab hours and there is a sizable cheque to write out. Another challenge is making the transition from a clinical environment with parallel bars and nice flat floors, to a real world environment that has bumps and steps and slopes and all manner of obstacles. It is a real eye opener to walk around with an amputee who is operating at their performance limit and seeing how simple obstacles you would not normally notice becoming major challenges. Our world is not very disability friendly and it is discouraging when access to your local cafe is so difficult that it easier not to go. I guess it also motivates you to overcome the obstacles as well and seek solutions that are novel.

What are the key attributes you feel are required for your area of work?

- Being a team player is important, especially if you are operating in isolation you need to be on the phone or email or in the car when things need to be sorted.
- Being flexible and incorporating new ideas.
- Moving on and taking a fresh look at a problem when things are not working.
- Being brave enough to ask for help! It has been a huge learning experience and the more inclusive you can be with as many people as possible the better. My experience pales in comparison to others who work in this field and I have been expertly guided along the way.
- Surrounding yourself with the right people and being supportive as a team member to work with the client is imperative.

By Andy Strang BPhty, PGCertHealSci (Clin rehab)

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www.sportsphysiotherapy.org.nz/resources

Physical game demands in elite rugby union: a global positioning system analysis and possible implications for rehabilitation

Coughlin G, Green B, Pook P, Toolan E, O'Connor S (2011).

Journal of Orthopaedic and Sports Physical Therapy 41: 600-605. doi:10.2519/jospt.2011.3508

Article Summary

The evolving nature of the game of rugby union has given rise to a bigger emphasis on skill acquisition and physical conditioning. The increase in the physical nature of the game has placed more importance on the sports medicine staff to develop injury prevention and management strategies. One way of doing this is to monitor and evaluate the physical demands of training and games on the players using global positioning system (GPS). By doing so appropriate conditioning and rehabilitation programmes that suit the players can be established. The objective of this study was to determine the physical demands on players during an international rugby union game using GPS.

This study had two participants; 1 forward and 1 back. They each had a GPS devise strapped to their back which recorded velocity, time, position, distance and direction as well as the number and magnitude of impacts. Locomotion data and an accelerometer in the device measured the number of impacts (measured in gravitational force (G)). The results showed that the back covered a greater distance than the forward during the game, and that they spent more time in the higher intensity running and maximal–speed running zones than the forward. The forward however, sustained considerably higher number of impacts and total body load (the sum of the number of impacts multiplied by the level at which they occurred) than the back; but the back had a greater percentage of total body load in the severe (10+ G) level. Both players covered similar distances at the higher intensity speed zone (18-24.1km/h) but the back had a higher total distance and higher than average speed than the forward. This is consistent in most games where backs cover greater distances in open play running and sprint more often.

This is the first study that has reported on the body loads sustained in tackles and scrums. The highest proportion of injuries are sustained during tackling and risk factors for these injuries have been indentified in previous studies. The back had more loads of over 10G, indicating the nature of the collisions in this position. This study reiterated the link between GPS data with video analysis and its assistance in the identification of mechanisms of injuries. This in turn benefits the player as the physical demands of the game can be established. GPS is also being used in the correlation of total distance run and prematch/postmatch muscle damage markers.

Clinical Implications

Players are required to recover quicker from competitions and injury; they also have to contend with the increasing physical demands of the game and the higher intensities of play. Medical staff can use GPS data to devise a position specific rehabilitation programme suited to the players' individual needs and therefore get them match fit quicker. GPS is going to become an integral part of the sports medical team and undoubtedly more research will include it in the future.

Reviewed by Charlotte Raynor MPhty, PGDipPhty, BSc (Hons), NZRP, MNZSP

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JOSPT

April 2013, Volume 43, Number 4

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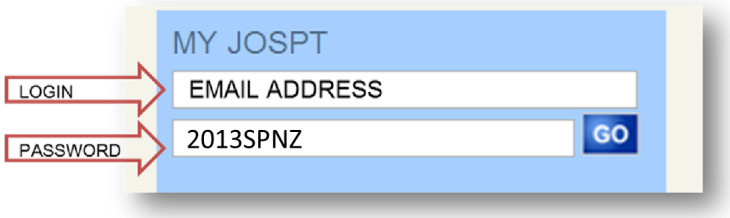

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International Journal of Sports Physical Therapy

Volume 8, Number 2 April 2013

IJSPT April 2013

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A comparison of two taping techniques (Kinesio and McConnell) and their effect on anterior knee pain during functional activities.

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Pre-participation screening: the sports physical therapy perspective.

Shoulder posterior internal impingement in the overhead athlete.

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ASICS REPORT

PRODUCT REVIEWS

TIGREOR 5

ASICS releases its 6th edition of the Tigreor with the ongoing technological advancements that it is known for. Six years ago ASICS used its running shoe science to make break through changes never seen before in football, all aimed at changing the mindset behind boot design. Tigreor 6 continues the legacy with features designed to improve speed, comfort and performance.

Football is similar to middle distance running/sprinting and requires the majority of movements to be performed on the toes at quick speeds. To assist faster transition to the toes Tigreor 6 has a 10mm gradient built into the boot from heel to toe (HG 10mm). Research has also shown a higher pitch in the heel helps unload the joints of the lower limb and this prevents injuries to the Achilles and hamstrings. The moulded outsole has different densities in the rear and forefoot making the vamp more flexible under the toes, improving acceleration and speed. The rear of the outsole maintains torsional stability required when breaking before a cutting movement or for the stabilising leg when kicking the ball.

Comfort has always been a standout feature of the Tigreor range and with a Solyte midsole (ASICS premium cushioning material) stud protection is maintained whilst keeping a plush underfoot feel on different surfaces. The new heel counter is not as rigid allowing the boot to accommodate most heel shapes and prevents the all too common blistering seen in poorly designed boots. The ample padding on the inside of the heel counter further enhances ASICS attention to detail and is a standout feature in overall fit. As in previous models there is a lateral support sleeve on the inside of the boot upper. This links into the laces which when pulled gives the boot an added feel of support and enhances the fit of the boot. The ASICS football range has a removable solyte sock liner making fitting any orthotic type a breeze. A Kangaroo leather upper completes the many features that have made Tigreor one of the most comfortable boots on the market.

The Tigreor outsole is available in both stud (4:2 configuration) and moulded versions for maximum traction on all playing surfaces. The moulded version has conical moulded studs that are well positioned to reduce blistering and pressure on the balls of the feet whilst releasing easily from the turf and resisting unnecessary loads on the knee e.g ACL ruptures.

This seasons model maintains ASICS leadership in technical performance, dropping the weight and improving flexibility in the forefoot. Tigreor 6 is packed with intelligent features designed to protect the player from injury without sacrificing comfort. Packing so much into a boot you would think the weight of the boot would increase affecting performance (a 100g increase in weight has a 1% energy cost). Surprisingly Tigreor with its many features has maintained a low weight profile making it the most technical performing boot on the market. The boot will suit the elite and non-elite players and those looking for features designed to protect against injury.

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When?	What?	Where?	More information
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30 Aug- 1st Sept 2013	The Leuko Tape Sport Physiotherapy Congress	Gauteng, South Africa	http://www.sport-physio.co.za/
2 Sept 2013	IFSPT Symposium	Cape Town, South Africa	http://ifspt.org/education/conferences/2013-ifspt-general-meeting-and-congresses/
25-26 Oct, 2013	Glasgow Sports Conference	Glasgow	
8-9 Nov 2013	Salzburg Sports Physiotherapy Symposium	Salzburg	http://spowww.sbg.ac.at/ssps2013/index.php?id=95
Nov 15, 2013	SportFisio 11th Annual Conference	Bern, Switzerland	http://r20.rs6.net/tn.jsp?e=0014PUpTeosLp3nXXroB4ozWJPfo1LkxFMNv3yvQ3Z-JB0Mwz91nQFceMRL-KAyUn0m7WgpdAohUiZdrLKteP2jXs8MJYrbtBKEu1YG4olSxupZCw0AmCawW85Lv0XEuD65j
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