Expert Opinion on Published Articles

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The utility of repeated postoperative radiographs after lumbar instrumented fusion for the degenerative lumbar spine

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Spine 2011;**36**(23):1955–60

This was a retrospective review done to assess the impact that routine postoperative radiographs have in clinical outcome and decision-making.

No standard exists that outlines how often and when radiographs should be taken after lumbar fusion.

Routine postoperative radiographs can be a source of inconvenience and cost to patients, radiation exposure, and possibly, confounding information.

This was a study of 63 consecutive patients undergoing instrumented lumbar fusion, either single or multilevel from L1 to S1. The initial presenting pathology was degenerative disease in all the patients. The mean follow-up period was 21.4 months (range 9–59 months).

At a total of 269 visits, radiographs were taken with an average of 4.3 ± 1.2 visits per patient. A total of 700 radiographs, including L5/S1 view (n = 72) and oblique view (n = 8), were taken with an average of 11.1 ± 4.4 radiographs per patient.

The results were very interesting.

Symptomatic patients were more likely to have abnormal radiographs – 22% (11/50) compared to those with no new symptoms – 2.7% (6/219). In the asymptomatic patients, radiographs revealed no clinically useful information, with the probability of an abnormal finding being significantly lower in the asymptomatic patients ($P < 0.001$).

Before the 6-month follow-up visit, abnormal findings were found in one of the 111 visits (0.9%) and in 16 of the 158 (10.1%) visits at the 6-month follow-up or later. The probability of an abnormal finding was significantly lower before the 6-month follow-up ($P < 0.001$), with most radiographs (99%) taken before the 6-month follow-up providing no useful treatment information. Pseudoarthrosis is defined as failure of solid fusion 12 months after surgery, and that is when a radiograph is required.

Radiographs are a common imaging modality used to evaluate for fusion. The accuracy thereof is controversial, with quoted sensitivity and specificity for fusion reported as 85% to 100% and 60% to 90% respectively, when compared to surgical exploration.

Diagnostic radiography also exposes the patient to ionising radiation, with both acute and long-term morbidity. The lifetime risk of radiation-induced carcinogenesis attributable to spine radiographs is not negligible. The effective doses for AP and lateral lumbar radiographs are 2.20 and 1.50 mSv respectively, approximately 25 times that of a standard chest radiograph.

The radiographs also add additional costs to the patient, medical aid funder or state institution. The approximate cost of a standard AP and lateral radiograph is R300. In this study an average of 11 postoperative radiographs were taken per patient, adding therefore an extra R3 300 to the expense.

This study has some limitations with it being retrospective, and it includes various surgical procedures in the study group. The number of patients was also too small to address any subgroup analysis.

Conclusion

Most radiographs (99%) taken before the 6-month follow-up provide no useful information. Plain radiographs after a lumbar-instrumented fusion should be ordered as clinically indicated. To confirm solid fusion, plain radiographs should be obtained at the 12-month follow-up or later. If unnecessary radiographs are avoided, risk to patient (radiation exposure) and cost to patient/state/medical aids can be decreased.

This study does illustrate the important concept of not doing an X-ray just because you can! Maybe it will stimulate us to rethink our routines.

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Wear in highly crosslinked polyethylenes

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This important publication has attracted worldwide attention. The prominent role of polyethylene-crosslinking in American hip replacement is confirmed. At the time of its publication in 2008, no less than 70% of hip replacements in the USA employed crosslinked polyethylene. The projection for 2010 was 90%! From approximately 300 000 hip replacements done annually in the USA, in excess of 175 000 were crosslinked, and over 1.5 million Americans have already received a crosslinked hip.

Part 1

The authors acknowledge the importance of reducing wear and oxidation, but as a team of bio-engineers, they were unable to confirm the close association between linear (2D) wear and particle-generated osteolysis. Next, a simplistic but sufficient report on basic polymer science pertaining to chemical structure and crystallinity is given. The process of crosslinking is made easy to understand and is a 'must read' for every arthroplastician as it brings clarity to the importance of annealing/remelting/free radicals, and oxidative degeneration.

Part 2

Arthroplasticians will value the section on the individual performance of four different commercial brands of crosslinked polyethylene employed in hip implants: Crossfire, Durasul, Marathon and Longevity. There were no reports of significant differences between the four brands and reduction in head penetration (2D wear) ranged between 20% and 95% (variable specificity). Unfortunately, all reported studies were that of short-term follow-up cases, with Charles Engh (Jr)'s mean follow-up the longest at only 5.6 years. Longer follow-ups are needed and should also address the specificity problem. Nevertheless, it can at least be said that there was no bad news, and that, in every series, crosslinked polyethylene resulted in reduction of wear and its consequences. The interesting aspect about the Charles Engh (Jr) study is the comparison of Marathon (crosslinked) cases with Enduran (virgin) cases: a clear improvement in **wear** (down by 95%) and osteolysis (down from 57% to 24%) in the crosslinked Marathon cases. A further 10 years' follow-up should prove very interesting.

Reviewer's opinion

The first part

In the foregoing commentary, we pointed out that, in our opinion, it is important to have a basic knowledge of crosslinking, annealing, remelting and oxidation. It should assist the clinician in making a sensible decision when selecting an implant for his arthroplasty patient. We believe that the authors have succeeded fully in this goal.

The second part

The authors' intention as declared in the abstract on p392, was to formulate a critical assessment of the literature on the subject of polyethylene crosslinking in clinical studies. We do not think that they succeeded in that goal: it must be realised that it is an extremely taxing task for three non-medical authors to scrutinise the literature over the career barrier into medical–surgical territory. The absence of a trained orthopaedic surgeon on the authors' panel probably contributed to the flawing of an otherwise excellent paper. The paper most certainly disappointed our multi-disciplinary South African research team, who was responsible for the original R&D of polyethylene crosslinking in hip arthroplasty in 1975.

We believe that the following difficulties could and should have been prevented:

- Research on polyethylene crosslinking did not commence as late as ±1995 as the authors state on p393, line 27. In fact, by far the most important R&D was already completed and comprehensively reported on, and published by 1978. We find it unacceptable that on p399, 18 from 21 references were from after 2008, and none before 2007.
- It should be pointed out that research on crosslinking was never limited to the USA. In fact all of the important pioneering research took place outside the States. American researchers commenced their crosslinking research almost 25 years later in the late 90s, but despite that, 16 of the 21 references are from the USA (p399). It therefore seems clear that the literature resources in this review cannot be seen as comprehensive, representative or unbiased.

The prominent role of polyethylene-crosslinking in American hip replacement is confirmed. At the time of its publication in 2008, no less than 70% of hip replacements in the USA employed crosslinked polyethylene

- In any article on crosslinking and longevity, certain pioneers of joint replacement surgery must be mentioned: Hagiwara M *et al*, Mitsui H, Wroblewski M, Charnley J, Harris W, Fisher J, McKellop HA, Willert H, Muratoglu OK, Dumbleton JH, Oonishi H, Clarke IC, Freeman M, and perhaps even the multidisciplinary South African Gamma-Crosslink research team (since 1974). Some references quoted by the authors simply have insufficient follow-up, for instance the excellent study by Charles Engh (Jr). However, the 5.7 years' follow-up is simply too short to have any place in the study of longevity. At least some of the many excellent studies published by John Fisher from Leeds should have been quoted – which would have brought extra credibility to any longevity-directed study.
- The controversy and uncertainty about the association between wear/penetration/osteolysis came as a surprise. The classic paper by Bill Harris, 'The problem is osteolysis', would have removed any controversy about the **association** of these variables if only it was included in their references. More recently this association was statistically confirmed in the *SA Orthopaedic Journal*, Autumn 2011 ('Thirty-three years of clinical experience with crosslinking of polyethylene in cemented total hip replacement' by CJ Grobbelaar, FA Weber and TA du Plessis).

Summary and conclusions

Unfortunately we found this important chapter vague and anecdotal, and some statements were simply inaccurate.

- p398, line 3: The statement that 28 mm heads were almost exclusively used in early clinical series is not true. Early series utilised only 30–36 mm heads but no 28 mm sizes. These crosslinked 30–36 mm sockets were implanted from 1976 to 1984 (two series of 1775 + 430 respectively) in South Africa and followed for up to 33 years.
- p398, line 8: The magnitude of penetration simply cannot be determined with less than 15 years' follow-up. The annual wear is too small to measure individually and it has to be a matter of arithmetic calculation. The international wear figure for gamma crosslinked polyethylene is ± 0.015 mm/year (mean). It was also the Pretoria experience and represents a six to seven times improvement over virgin polyethylene.
- p397, line 120: 'wear reduction' is not a 'hypothesis' as stated by the authors. It is a factual finding, that becomes **reality only** after literature from the entire world and over 40 years is studied. Unless we study the bigger picture it may remain only a **hypothesis** indefinitely, which unfortunately seems to have been the choice of the authors.

NB: The '**critical appraisal**' that the authors intended to level at various clinical series therefore can only be justified after comprehensive study of all international literature by them – not only from the USA; and over the entire research period of the given topic (40 years) – not only the past 12 years.

Finally

This otherwise excellent review was marred by the exclusion of European, Japanese and South African research reports, as well as reports from the 70s, 80s and early 90s. Some of the most important pioneering research on crosslinking is thus excluded from the report which thus cannot be considered to be representative. It nevertheless remains an important keynote report which can help us to formulate our choice of implant for our specific patient. The important prerequisite is that we should be objective and fair towards all literature – the facts are there! It was proved over three decades that crosslinking has changed polyethylene into a new material, both chemically and mechanically. By limiting wear, we limit osteolysis and pain for at least six times longer, and by protecting the interface, we are enabled to sustain implant fixation almost indefinitely.

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Direct and indirect loading of the Ilizarov external fixator: the effect on the interfragmentary movements and compressive loads

Jan Gessmann, Hinnerk Baecker, Birger Jettkant, Gert Muhr, Dominik Seybold
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This is an experimental study that raises some very important questions for those of us who look after patients in circular external fixators.

Circular fixators are most commonly used for problems affecting the lower limb, ankle or foot, and as such, often extend down into the foot with the frame supporting the foot through fine wires, half pins or both.

The extension of the frame down into the foot makes weight bearing quite uncomfortable for the patient, and coupled with the fact that the patient cannot wear shoes with a frame that extends into the foot, means that most limb reconstruction surgeons opt for an orthosis to facilitate weight bearing. This orthosis normally comprises a base plate that bolts onto the bottom of the frame and thus provides a weight-bearing platform to facilitate the patient's walking.

The study reported on in this paper is an experimental study where the loading pattern of a circular fixator is compared with and without a footplate extension. A fracture gap model was created and bench tested under various axial loads with or without the footplate. Load transfer was measured in the bone and the frame and compared between the two groups. It was clear that a footplate, at least experimentally, substantially changes the biomechanical behaviour of the circular external fixation device. Limb reconstruction surgeons believe that the fine wire fixators impart optimum healing potential through the unique biomechanical milieu they provide. The findings of this study beg the question whether a foot plate extension does not fundamentally change the unique biomechanics of the device to the detriment of the bone healing site and ultimately the patient.

Although this is an experimental study with some significant limitations, it does open the debate as to whether we should be adding bits and pieces to a fixator that has proved its worth over the last half century or so.

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Current concepts review: Traumatic disorders of the first metatarso-phalangeal joint and sesamoid complex

AR Kadakia, A Molloy

Foot & Ankle International; August 2011;**32**:834

General 'turf toe' is a term bandied about by sports medicine doctors and very few well-structured articles about this have been published.

This is a very good overview article of this area, which can cause very disabling injuries. The anatomy and functioning of the MP joint of the big toe is discussed and it is again reiterated how much weight this area carries, namely 32% of energy generated during sprinting activities.

The importance of the sesamoids and the whole flexor complex is central to stability and good function in this area.

The clinical presentation of injury in this area is swelling and ecchymosis. It is usually the result of an acute injury.

The clinician must assess the injury, make an accurate diagnosis and then plan treatment in a structured fashion.

This is what the article sets out to achieve.

It should be noted that stress fractures can also occur in this area but are not very common.

Imaging consists of initial plain radiographs and, if sesamoid injuries are suspected, lateral 40° oblique and medial 40° oblique views can be taken to better visualise the two sesamoids.

Isotope scans are non-specific but can indicate pathology in this area.

MR is probably better than CT because it defines soft tissue injuries.

The following groups are recorded:

- **Turf toe**
  This is divided into three grades, starting basically with a strain of the capsule and without lost continuity progressing through a partial tear of the capsule to complete tear of the capsule and plantar plate with loss of continuity and very often a proximal displacement of the sesamoids.
  The grade 1 and grade 2 injuries are treated conservatively with rest, physical therapy and non-weight bearing.
  With regard to the grade 3 injuries, these probably need surgical repair, although a large series of surgical repairs has not been published to prove its worth.
  Most of these injuries occur in people who have their big toe in a hyper-dorsiflexed position with the ankle in equinus and full weight applied to the heel and transmitted through to the big toe. They are often wearing light sport shoes.

The anatomy and functioning of the MP joint of the big toe is discussed and it is again reiterated how much weight this area carries, namely 32% of energy generated during sprinting activities

- **Traumatic hallux valgus**
  This is a scarce variant of turf toe and appears to have a worse outcome. What normally occurs is that the big toe dislocates with avulsion of the medial collateral ligament off the metatarsal head. It is very often reduced, either next to the field or in the casualty situation and is then left. These need acute repair otherwise a significant hallux valgus develops in a short space of time.

- **Hyper-flexion sand toe**
  This is the opposite of a turf toe and is commonly seen in beach volley ball with hyper-plantar flexion of the big toe. This leads to tearing of the dorsal capsule; there is usually concomitant involvement of the lesser toes. The toe is rested and as the oedema subsides an exercise programme is instituted basically giving good results.

- **Sesamoid fractures**
  Acute fractures can be treated non-operatively except in the scarce instances where there is gross displacement. Treatment usually means protected weight bearing in a surgical shoe. Open reduction has only been described as case reports and some of these were for chronic non-unions. Again weight bearing in a stiff soled shoe is acceptable post-surgical treatment.

- **First metatarsal head articular injuries**
  This is a rare injury and again conservative treatment is probably all that is needed. There is some limited evidence suggesting that operative treatment may be open or arthroscopically done and a debridement of the joint and drilling of an osteochondral defect could be beneficial. A loose fragment causing mechanical problems in the joint obviously would need surgery to remove it.

In summary, the following is the message of the review:

- These injuries can lead to substantial disability.
- Clinical evidence for treatment of so-called 'turf toe' is fairly well developed.
- Traumatic hallux valgus must be carefully monitored and acute repair seems to enjoy fair success.
- Sand toe needs non-operative treatment.
- Acute sesamoid fractures are treated non-operatively as a primary treatment.
- Osteochondral injuries can usually be treated either open or arthroscopically.

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Total ankle replacement in obese patients: Component stability, weight change, and functional outcome in 118 consecutive patients

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The incidence of obesity is rising so significantly that the experts are calling it an epidemic.
Obesity is a lifestyle disease and is known to increase the risk for heart disease, diabetes, stroke and certain forms of cancer. Furthermore, obesity has been implicated as a negative predictor of success in patients with total knee replacement (TKR) or total hip replacement (THR).

There are no comparable studies, however, addressing outcomes of total ankle replacement (TAR) in obese patients. In this (IFFAS award 2011) retrospective study, the authors looked at the effect of obesity (BMI ≥ 30kg/m^2) on TAR with respect to:

- intra- and peri-operative complication rates
- mid-term (average 5.2 years) survivorship of prosthesis components and surgical revisions
- BMI and weight change at 1- and 2-year follow-up
- mid-term (average 5.2 years) functional outcomes including range of motion (ROM) and patient satisfaction.

The subset of 118 patients (123 TAR) was part of a larger prospective study including all patients who underwent TAR between May 2000 and June 2008. Sixty-one male and 57 female patients with a mean age of 59.8 (range, 25.4–79.4) years and pre-operative BMI of 32.9 (range, 30–40) kg/m^2 were included. The cause of the arthritis ranged but by far the commonest was post-traumatic osteoarthritis (81.3%).

As expected, with obesity being a lifestyle disease, 24.6% of patients had at least one concomitant comorbidity, including hypertension, hypercholesterolaemia, coronary heart disease, diabetes mellitus, cardiac arrhythmias and hypothyroidism.

The HINTEGRA, non-constrained three-component system was used and the procedure performed by the senior author (Beat Hintermann).

Standard clinical evaluation, radiographic measurements and statistical analysis were carried out.

To highlight certain points:

- Obesity (BMI ≥ 30 kg/m^2) was defined according to the WHO criteria and clinically significant weight loss as 5% or more of the baseline weight according to the US Foot and Drug Administration.
- Two independent reviewers (who did not perform the operations) assessed all patients pre and post-operatively in the outpatient clinic.
- The AOFAS hindfoot score was used and patients rated their pain on a visual analogue scale.
- The radiographic measurements are described in detail in the article.

Nine ankles (7.3%) developed intra-operative complications and eight patients (6.5%) had delayed wound healing.

Of note, however, was the 9.8% incidence of symptomatic DVT at a mean post-operative time of 5.7 (range, 3–11) days. This being much higher compared to 3.9% in a previous study of 665 patients who underwent TAR (by the same group).

The follow-up averaged 5.2 ± 2.2 (range, 2–10) years. The survivorship analysis showed a prosthesis metallic component survival of 93% (two ankles were revised and four ankles were converted to ankle fusion). Secondary surgery was performed in a further 13.8% at a mean of 1.9 years.

Noteworthy points that came out of this study are as follows:

- No prior study has ever been done addressing functional outcome and prosthesis stability in obese patients with TAR.
  - It is interesting to note that no case required a change of the mobile bearing. Whether this was done in conjunction with the revision or secondary surgery is not known.
  - It is also interesting to note that the authors were very specific as to what constituted 'component survival'. They regarded only the prosthesis **metallic** component survival. In my experience, it is the plastic in-lay that is commonly revised.
- The survivorship of 93% at 6 years is comparable to world literature for TAR implants (defined as the retention of metal components).
- A noteworthy result was that 11.9% of patients lost weight at 1-year follow-up using the 5% criteria. This was mainly noted in male patients and not to age or post-operative sports activity as one would have expected.
- The incidence of approximately 10% of symptomatic DVT, in my opinion, is significant and although the authors advocate the use of chemical thrombo prophylaxis, only in obesity, previous venous thromboembolism and absence of full post-operative weight bearing, I feel that 10% incidence is high enough to routinely cover TAR patients with anticoagulation. The use of the new generation oral anticoagulants (effectiveness, ease of use and no monitoring required) should make the decision to cover easier.
- Even though the majority of patients experienced post-operative relief, only 28% of patients were completely pain-free at the latest follow-up. This again fits in with world literature.
- There was a statistically significant increase in ROM though it has been noted in previous studies that improvement in the ROM is not one of the most expected benefits from TAR.

Several limitations were reported. The most significant, though, in my opinion, is that the surgeon, and senior author, is an extremely experienced ankle arthroplasty surgeon and the developer of the HINTEGRA. Even if the reviewers were independent of the surgery, one would expect the overall results to be superior compared to those from a general foot and ankle surgeon.

In conclusion, obesity is only one factor to consider in the decision making for TAR. As long as the patient is a good candidate for TAR in all other respects, obesity is not a contra-indication to TAR.

It cannot be emphasised enough, however, that 'to achieve good outcome, the TAR should be performed by an experienced foot and ankle surgeon who is familiar with this procedure'.

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Distal rectus femoris intramuscular lengthening for the correction of stiff-knee gait in children with cerebral palsy

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Lower extremity soft tissue surgery is commonly performed in spastic diplegia. A stiff-knee gait pattern is attributable to inappropriate activity of the rectus femoris during late stance and into swing phase of the gait cycle thus reducing peak knee flexion in swing. This results in interference with foot clearance. Rectus contracture can be demonstrated clinically by the Ely and pendulum tests and gait analysis studies. The most widely accepted treatment to address stiff-knee gait is rectus femoris transfer. The distal rectus femoris tendon is dissected from the underlying vasti. The tendon is tenotomised near its insertion to the patella and transferred more commonly to one of the hamstrings or to the iliotibial band. The procedure is usually combined with hamstring lengthening and is supposed to eliminate the knee extension effect of the spastic rectus femoris during swing, converting the rectus from a knee extensor to a knee flexor.

However, the authors of the above article quote recent studies using intramuscular electrodes to stimulate the rectus femoris and found that a knee extension moment was produced following rectus transfer. Other studies using MRI 3D reconstruction showed that the transferred tendon followed an acute path and had scar formation between the tendon and the muscles. They concluded that the beneficial effects of rectus femoris transfer are derived from diminishing the effects of the extensors rather than converting it to a knee flexor.

The beneficial effects of rectus femoris transfer are derived from diminishing the effects of the extensors rather than converting it to a knee flexor

The authors evaluated the effects of a novel procedure of rectus femoris intramuscular lengthening to treat stiff-knee gait in ambulatory patients with cerebral palsy. They studied 42 patients (69 sides) over a 17-year period with an age range of 4.3–14.9 years. The tendinous raphe of the rectus was exposed through an anterior incision over the mid anterior thigh and 1.5–2 cm of the tendinous portion was resected and allowed to retract. Compared to pre-operative values, post-operative gait analysis revealed patients to have an earlier timing of peak knee flexion in swing phase of the gait cycle, less crouch and maintenance of peak knee flexion. Patients who underwent soft tissue surgery only, benefited more from the procedure than those who also underwent bony surgery. Rectus femoris intramuscular lengthening diminishes the knee extensor function of the rectus femoris and may thus offer a less technically demanding alternative to rectus transfer in the treatment of stiff-knee gait in combination with hamstring release.

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