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Mr. Peregrin Sandheaver
115 Lady of the Lake Boulevard
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March 31, 2017

Mr. Sandheaver,

In addressing your questions and the information with which you were presented regarding your client, Mr. Emerson, I have uploaded a number of images related to the hip injury demonstrative of the complexity of the joint. Additionally, through the same portal I have uploaded a number of documents supporting the assertion that there is a greater likelihood of need for Total Hip Arthroplasty ([THA] hip replacement) in the face of more complex fractures.

Of significance is the nature of the traumatic fracture. While a fracture, quite simply, is an interruption in the structure of a bone, there are many types of fracture. The two relevant to this case are simple and comminuted (complex). A simple fracture is, as it sounds, a single break in the structure of a bone. This break may be partial or complete. If complete, there is risk of displacement which may cause significant pain as well as injury to surrounding soft tissues (muscle, nerves, blood vessel, tendons, or ligament).

Complex fractures are sometimes comminuted (these terms are used interchangeably in this report). Comminuted fractures are fractures in which the bone is disrupted in such a way as to fragment into more than the two pieces seen in simple fractures.

In the case of Mr. Emerson, the comminuted acetabular (socket portion of the hip joint) fractures of both anterior and posterior columns essentially left the frame of the hip joint open and in at least six pieces. Surgery to correct this defect in structure was necessary and will leave behind a number of concerns for the future of the patient related to hip health.

A short overview of fracture healing is necessary to adequately demonstrate the need for future care evinced by the injuries described.

Bone healing is usually divided into three stages that are fairly linear though they do tend to overlap somewhat: inflammatory, reparative, and remodeling. A time frame for each phase is impossible to estimate because healing rates vary widely according to age and comorbidities. For example, a simple toe fracture in a healthy young child may heal completely in four weeks while the same fracture in a 65 year old diabetic smoker may not heal completely for several years.

The inflammatory phase is predominantly vascular in nature events. Following a fracture, a hematoma forms which provides the building blocks for healing. Subsequently, reabsorption occurs of the 1 to 2 mm of bone at the fracture edges that have lost their blood supply. It is this bone reabsorption that makes fracture lines become radiographically

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distinct 5 to 10 days after injury. Next, other cells are transformed into osteoprogenitor cells, which begin to form new bone.

In the reparative phase, new blood vessels develop from outside the bone that supplies nutrients to the cartilage, which begins to form. Nearly complete immobilization is desirable during both the inflammatory phase and the early reparative phase to allow these new vessels to grow properly. However, once neovascularization (growth of new blood vessels) is complete, progressive use of the body part across the fracture site aides in callus formation.

Callus typically forms as a new collar of endochondral bone around the fractured area. This callus is predominantly cartilage, but hardens during the remodeling phase. Late in the reparative phase, clinical union of the fracture occurs. Clinical union occurs when the fractured bone does not shift on clinical examination, the fracture site is nontender, and the patient can use the injured limb without significant pain. Because the initial callus is cartilage, clinical union may occur before evidence of union is seen on X-ray. Clinical union classically marks the end of the reparative phase of fracture healing.

In the remodeling phase, the endochondral callus becomes completely ossified (hardened bone) and the bone undergoes structural remodeling. The process of remodeling occurs quickly in young children, who remodel their entire skeleton every year. By late childhood, the rate of skeletal remodeling is approximately 10 percent per year and continues near this level throughout life.

Of note is the loss through resorption of 1-2mm of structural bone that is then remodeled as healing progresses. This is notable because of the tolerances of the hip joint to variations in its size and shape. In Kreder (2006), it is shown that "[a]natomical reduction alone was not sufficient to restore function. The fracture pattern, marginal impaction and residual displacement of >2mm were associated with the development of arthritis, which related to poor function and the need for hip replacement." There is a strong correlation between complex fracture and arthritic joint disease shown in Dunet (2013) where the study included twenty-seven (27) patients with complex acetabular fractures and demonstrated a rate of THA of 92.6% (25 of 27 fractures) with a mean time to surgery of less than four (4) years.

As explained in the overview of fracture healing, the remodeling of bone will, more likely than not, result in an uneven structural presentation and an ill-fitting joint. This is even more likely given the totality of the injuries suffered by Mr. Emerson. Not only were the acetabular columns fractured as well as the femur below the trochanter (the angled portion that transitions from the straight thigh bone to the ball head that fits into the hip joint) but the femoral head (the ball of the ball and socket joint) was also fractured. Though the subtrochanteric fracture of the femur displaced and was repaired this will not directly affect the fit of the ball and socket. It is, on the other hand, the direct

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damage to those two structures (the acetabular columns and femoral head) and their subsequent healing and remodeling that will affect the shape of the joint and determine the outcome relative to arthritis in the future.

While surgical techniques continue to improve on an almost daily basis, think of putting together a three-dimensional jigsaw puzzle of no less than six pieces that are held together by rubber bands and covered in WD-40. That's essentially what these surgeons were trying to do. In addition, they had to end up with pieces that not only align within 2mm now, but don't remodel to include additional cartilage or bone in the future that takes 2mm of space out of that joint on at least three sides.

Malloy (2017) provides no insight into the clinical indications for THA, only an overview of the costs of such a procedure during the study period. In the Giannoudis (2005) paper a meta-analysis is conducted. These style papers are used specifically to determine the need for better constructed studies or additional studies in a given area as they are merely an aggregation of statistical data from prior clinical studies and trials with a new analysis of that aggregated data.

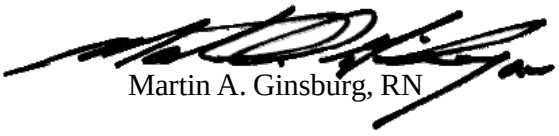
Kellam (2016) is yet another meta-analysis, with more recent studies, to be sure, but lacking in specificity to the issues at hand. The analysis relates to AVN (avascular necrosis – a lack of blood vessels and blood flow leading to a death of tissue) and Post traumatic arthritis after traumatic hip dislocations. The study dilutes the impact of complex fractures by its inclusion of simple fractures and, potentially, non-fracture traumatic dislocations.

The literature proffered is lacking in applicability to this case and dilutes the significance of the injuries sustained by Mr. Emerson through inclusion of irrelevant subjects and materials.

While the hip fracture was the primary focus of this writing, it should be noted that the contralateral tibial spiral fracture and repair may adversely impact the function of this hip, especially during the inflammatory and reparative stages of healing where body mass is shifted from one point to another in an effort to mitigate pain. This is likely to delay full healing of both fractures.

It has been my pleasure and privilege to have the opportunity to assist in this matter. If there are any questions I might answer, or clarifications needed to aid in the utilization of these materials, please contact me.

Respectfully,



Martin A. Ginsburg, RN

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Bibliography

Briffa, N., et al. "Outcomes of acetabular fracture fixation with ten years' follow-up." *Bone & Joint Journal* 93.2 (2011): 229-236.

Dunet, B., et al. "Acetabular fracture: long-term follow-up and factors associated with secondary implantation of total hip arthroplasty." *Orthopaedics & Traumatology: Surgery & Research* 99.3 (2013): 281-290.

Giannoudis, P. V., et al. "Operative treatment of displaced fractures of the acetabulum." *Bone & Joint Journal* 87.1 (2005): 2-9.

Kellam, Patrick, and Robert F. Ostrum. "Systematic review and meta-analysis of avascular necrosis and posttraumatic arthritis after traumatic hip dislocation." *Journal of orthopaedic trauma* 30.1 (2016): 10-16.

Kreder, H. J., et al. "Determinants of functional outcome after simple and complex acetabular fractures involving the posterior wall." *Bone & Joint Journal* 88.6 (2006): 776-782.

Molloy, Ilda B., et al. "Effects of the Length of Stay on the Cost of Total Knee and Total Hip Arthroplasty from 2002 to 2013." *JBJS* 99.5 (2017): 402-407.

Romness, DAVID W., and DAVID G. Lewallen. "Total hip arthroplasty after fracture of the acetabulum. Long-term results." *Bone & Joint Journal* 72.5 (1990): 761-764.

de Toledo Lourenço, Paulo Roberto Barbosa, and Robinson Esteves Santos Pires. "Subtrochanteric fractures of the femur: update." *Revista Brasileira de Ortopedia (English Edition)* 51.3 (2016): 246-253.