PSEUDOTUMORS IN ASSOCIATION WITH HIP PROSTHESES:
A LITERATURE REVIEW WITH CASE STUDIES

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Abstract

With the exhibit of pseudotumor discoveries around hip replacements, the search for the cause of such abnormal masses has become a topic of great interest. Possible areas of causation include metal-on-metal hip replacements compared to metal-on-polyethylene hip replacements, patient hypersensitivity to prosthesis debris, or even prosthesis surgical position has been investigated. Although more research should be done, hypersensitivity seems to be the direction most studies are suggesting. However, more research must be done to ascertain the true reason behind the development of pseudotumors.
Introduction

Pseudotumors, although rare, have become an area of common focus among Orthopedics performing hip replacements. With these newly seen formations, large amounts of research have gone into the cause of such phenomena. Questions have been raised as to why they develop. The focus of most literature has been on type of hip prosthesis, acetabular cup position, wear debris from prosthesis, increased metal ion levels, and hypersensitivity. Still, after all the research performed no definite answers have been found. To find the cause of these abnormalities, more evidence must be gathered.

Literature Review

Defining the Pseudotumor

Pseudotumors in relationship to hip replacements (HR) have been described in a very general sense. Matthies, Skinner, Osmani, Henckel, and Hart (2011) defined it as “…sterile inflammatory lesions found in the soft tissues surrounding metal-on-metal [(M-M)] and metal-on-polyethylene [(M-P)] hip arthroplasties” (p. 1895).

Hart et al. (2012) termed the pseudotumor as “sterile, inflammatory lesions within the periprosthetic tissues and have been variously termed masses, cysts, bursae, collections, or aseptic lymphocyte-dominated vasculitis-associated lesions (ALVAL)” (p. 317). This is a very good way of defining the pseudotumor and should be a way of keeping all studies focused in one direction.

There have been simpler ways that these masses have been defined. Campbell et al. (2010) described it as “…periprosthetic tissue reactions around [M-M] [HR]” (p. 2321). This of course could range from anything associated with the prosthetic making it difficult to visualize anyone one thing.
With all these varying definitions, studies have been broad and difficult to hone and create. To cover all these adverse definitions the term pseudotumor will be used for the purposes of this review. The cause of pseudotumors is still unknown to this day. Many hypotheses have been tested but still no clear answer has been formulated.

**Symptoms of Pseudotumors**

When a pseudotumor is suspected the underlining symptom is usually pain around the hip area. There are also numerous reports of a groin mass that is palpable and tender. Howie, Cain, and Cornish (1991) said they noticed “a firm, slightly tender, fixed mass in the groin…” (p. 30).

Although pain is typically associated with the mass, Malviya and Holland (2009) found that the mass did not cause “…any pain, clicking, squeaking, grinding or discomfort related to the hip…” (p. 478). This statement infers that not all pseudotumors are actually noticed and many could have them without even knowing.

**Pseudotumors in Two Types of Hip Prostheses**

Many recent studies involving pseudotumors have been centered on M-M HR. The idea that perhaps reactions to metal wear debris could be the cause. The frequency of M-M HR having pseudotumors has been investigated in several patients. Beaulé (2011) found in a sample of 3432 M-M hip resurfacing that “there were four surgically confirmed pseudotumors for a prevalence of 0.10%” (p. 119).

In another study of 670 (M-M) hip resurfacings, Malviya and Holland (2009) stated that “[two] patients were found to have [pseudotumors]” (p. 478). This shows a prevalence of 0.30% in their study. Pandit et al. (2008) found from 1300 M-M hip resurfacing that 12 pseudotumors had developed. They estimated "the incidence to be approximately 1% at five years" (p.850).
Although an increase of reports have been made with pseudotumor findings, from these studies it appears that the frequency of pseudotumors is rare overall.

Research involving M-P HR have not been pursued as recent as the M-M HR. However, these studies show that pseudotumors have been involved in M-P HR. Tallroth, Eskola, Santavirta, Konttinen, and Lindholm (1989) working with 417 patients with M-P HR reported that “4.6% of our revision arthroplasties of the hip had radiographic evidence of these lesions” (p. 574).

Similarly, Howie, Cain, and Cornish (1990) found 7 of 121 cases with “the incidence of [pseudotumors] in our revised Wagner arthroplasties was 5.8%...” (p. 31). This shows an actual higher frequency of pseudotumor occurrence’s compared to M-M HR.

An interesting study was performed more recently in relation to M-M and M-P HR and pseudotumor analysis. Although the sample size was small, the measure of pseudotumor prevalence in M-M HR compared to M-P pseudotumor prevalence was evaluated. Williams, Greidanus, Masri, Duncan, and Garbus (2011) compared a group of asymptomatic patients with recent HR. Among the M-M group there were 31 patients. The M-P group had 24 asymptomatic patients. It was found that “pseudotumor formation was significantly more frequent in the [M-M] total hip arthroplasty group compared with the [M-P] total hip arthroplasty group...” (p. 2164). The findings were that 42% of the M-M HR group had pseudotumors. In the M-P HR group the number presenting with pseudotumors was a mere 13%.

**Acetabular Cup Position**

One accessed cause for a pseudotumor is the positioning of the acetabular cup position. If the cup is put at too steep an angle or incorrect angle, this could lead to excessive wear on the
cup. Murray et al. (2011) stated that the “optimal orientation is 40-45 degree inclination and 20-25 degree anteversion” (p. 281).

Some research has been done which show this might have an effect on pseudotumor formation. Murray et al. (2011) concluded that “the further the component is from [the correct position] the more likely it is for a [pseudotumor] to occur (p. 281).” Pandit et al. (2008) stated:

There is weak evidence of a relationship between the inclination of the acetabular component and the time of onset of symptoms; steeply positioned cups are more likely to lead to edge loading thereby generating a large amount of metal debris (p. 281).

There is also contradictory evidence against cup position and pseudotumor prevalence. Hart et al. (2012) found that “no clear association between the presence of a pseudotumor and acetabular component position was identified” (p.317). It was also found by Matthies et al. (2011) that “the proportion of patients demonstrating evidence of a pseudotumor in well-positioned hips was similar to those with adverse cup positions” (p. 1895).

**Prostheses Wear**

One possibility for the cause of these masses is worn particles coming off of the hip implant. The prostheses must associate with another material to create the hip joint. With this articulation, rubbing occurs which causes the materials of the implant to wear. This causes particles to be released from the prostheses causing reactions by the immune system.

This wear may be the cause of pseudotumors suggested by some studies. Campbell et al. (2010) “Pseudotumor-like reactions can be caused by high wear…” (p. 2321). Although no decisive conclusion was made by the group because of lack of evidence produced. Howie et al. (1990) concluded that “[pseudotumors] may occur in association with severe wear on the polyethylene components of any design of hip arthroplasty” (p. 31).
Other studies have concluded that this isn’t the cause, but could relate to what is creating these pseudotumors. Matthies et al. (2011) stated that there was “no significant association between the presence of a pseudotumor…and component wear rates” (p. 1905). Similarly Glyn-Jones et al. (2011) postulated that “pseudotumors may be caused by a different mechanism…rather than toxicity to metal wear debris” (p. 2187).

**Increased Metal Ion Levels**

With the wear of these prostheses there has been an association with an increase in metal ion levels found in the patient’s serum. As metal debris is given off by the friction of the prosthesis, the metal enters the bloodstream causing an increase in these ion levels.

There are some studies that suggest that having higher metal ion levels may be the reason for pseudotumor development. Williams et al. (2011) devised that “…it appeared clinically that metal ions likely played a central role…[in pseudotumor development]” (p. 2170).

Conversely, some studies have stated that there doesn’t seem to be a direct association between pseudotumors and metal ion levels. Matthies et al. (2011) deduced that “pseudotumors were not associated with…metal ion levels” (p. 1895).

**Hypersensitivity**

Another area of investigation that may be causing pseudotumors is hypersensitivity. This has been described as wear from the hip prosthesis which causes some patients an abrupt response. Similar to an allergy to prosthesis debris, some patients present an immune response by creating a pseudotumor.

Many studies have found that this could be the cause of pseudotumors. Campbell et al. (2010) stated that “pseudotumor-like reactions can be caused by…a hypersensitivity reaction” (p. 2321). Similarly Glyn-Jones et al. (2011) came to the conclusion after their study that “at least
some diagnosed “pseudotumors” may be caused by a different mechanism, such as allergy…” (p. 2187). Another study by Matthies et al. (2011) who postulated that “patient susceptibility is likely to be more important [to pseudotumor formation] (p. 1895).

From all studies, no strong evidence against hypersensitivity and pseudotumor formation has been stated. However, no strong evidence has been reported to truly say this is the cause. For this reason, more evidence is needed to address that hypersensitivity is the leading cause of these masses.

**Case Report 1**

Watters et al. (2010) presented a pseudotumor case report identifying a 75 year-old man who had received a left M-M HR in November of 2007. The patient was without pain until 12 months later when he had swelling in his left lower extremity and pain in his thigh.

The patient received an x-ray, (See Figure 1) ultrasound, and computed tomography (CT) scan. The CT image showed fluid collection in the thigh. The patient sought a second opinion in January of 2009 when the pain and swelling persisted. Using magnetic resonance imaging (MRI), an abnormal fascial edema in the medial and posterior compartments around the M-M prosthesis was found. (See Figure 2)

The patient then presented to the Duke University Medical Center, in Durham, North Carolina in April 2009 for further evaluation. Using ultrasonography a 6-cm mass compressing the femoral vein near the prosthesis was found. A diagnosis of a pseudotumor due to a hypersensitivity reaction was considered. The patient was then scheduled for an open biopsy to rule out a hypersensitivity reaction and then to receive a revision M-P HR.

When the operation was underway, a thickening of the left hip joint capsule was observed and “necrosis of the soft tissues extending from the subcutaneous fat directly down to the
implant itself” (Watters et al., 2010 p. 1667). The hip prosthesis was loose at both the femoral and acetabular sites and were removed easily. Samples of the thick hip capsule where taken, and from around the soft tissues. A hip spacer was placed into the patient to help heal the infection. The findings from the sample match up with pseudotumors.

After the surgery a follow-up was given and the patient seemed to be doing well with no adverse reactions. The patient was offered a M-P total hip replacement but the study never stated whether they received it or not.

**Case Report II**

Picardo, Al-Khateeb, and Pollock (2011) presented a case of a 71 year old lady who had received a left uncemeted total hip arthroplasty M-P. Five years after her M-P HR she had stated that she had pain radiating from a groin mass on her left side for about 8 months which had decreased her walking distance.

X-rays were taken and the prosthesis showed no signs of loosening but showed a well-placed implant. (See Figure 3) She then received an MRI scan which showed a left side mass surrounding the prosthesis measuring 4.3cm x 5.2cm. (See Figure 4) The mass was compressing the femoral vein. A biopsy of the mass was taken and revealed “necrotic tissue with macrophage and lymphocytic infiltrate” (p.765), but no signs of infection or malignancy.

Revision surgery was started for another total hip arthroplasty and a large amount of inflammatory tissue was observed which passed into the hip joint. No loosening or wear was seen on the polyethylene cup. The mass was removed and the cup was replaced with a ceramic-on-ceramic HR. The samples taken from the tissue showed similar findings to a pseudotumor.

The patient healed normally without any adverse reactions. She had follow-up images taken using MRI six months later showing pseudotumor formation dissipated. The ceramic-on-
ceramic HR seemed to have solved the problem. No more symptoms have persisted at the conclusion of the study.

Discussion

Pseudotumor has been defined in such a broad sense that it has made it difficult for clinicians to thoroughly study them. If the term were more clearly defined with parameters, studies could be done with more focused results. There still controversy about cause of pseudotumors found in conjunction with HR.

It is still unclear as to whether prosthesis material has any association with pseudotumor formation. Research has contradicted itself in the studies performed showing that neither [M-M] nor [M-P] have any significant higher findings insisting that pseudotumors can be associated with either.

Uncertainty exists on whether acetabular cup position, prosthesis wear, metal ion levels, and hypersensitivity has any causable effects on the formation of pseudotumors. No conclusion can be drawn as to if a correlation does exist within any of these topics presented.

Most authors seem to formulate that some type of all-encompassing affect may be the cause. Yet, no study has been able to confirm anything with any degree of certainty. One aspect that may help with the study of these masses is more specificity when defining what a pseudotumor is. There must also be more randomized tests dealing with patient and pseudotumor formations to either rule out or diagnose the cause of the pseudotumor associated with hip arthroplasties.
**Figures**

**Figure 1.** Anteroposterior radiograph of the left hip, showing no evidence of implant loosening or osteolysis.


![Anteroposterior radiograph of the left hip](image1)

**Figure 2.** T2-weighted axial magnetic resonance scan proximal to the lesser trochanter, showing a mass effect of the diffusely thickened soft tissues surrounding the left hip joint.


![T2-weighted axial magnetic resonance scan](image2)
**Figure 3.** AP and lateral radiographs showing metal-on-polyethylene THA five years after implantation with no signs of loosening or heterotopic ossification.


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**Figure 4.** Axial PD-weighted MRI scan 6 months after demonstrating a large irregular fibrotic mass deep to the femoral vessels measuring 4.5 x 4.5cm in transverse dimension. The femoral vies is clearly patent.

References


