

MEMORANDUM FOR JOHN GOODE,  
BIOMEDICAL ENGINEER

September 15, 1999

FROM: John Dawson

SUBJECT: Reclassification Petition for Constrained Hip Prosthesis  
(Final), by the Orthopedic Surgical Manufacturers Association

It appears that the new material in the final version is at 'pages 34A-B and 37A-E. Pages 37A-E have tabular summaries of information from the journal articles that were in the original version. That information includes counts and percentages of various kinds, but the deficiencies in terms of defining rates and accounting for variations in patient follow-up duration remain unchanged. To provide a valid quantitative basis for the petition, I think they would have to get and analyze patient data.

I see no reason to reason to modify my original review reported in my June 28, 1999 memo to you.

MEMORANDUM FOR JOHN GOODE,  
SCIENTIFIC REVIEWER

June 28, 1999

FROM: John Dawson

PEER REVIEWER: Chang Lao, Ph.D.

SUBJECT: Reclassification Petition – Constrained Hip Prosthesis, by  
Orthopedic Surgical Manufacturers Association (OSMA): Statistical Issues

This petition is for “reclassification of a constrained metal/polymer hip prosthesis, cemented or uncemented, from [preamendment] class III to class II,” (p.3) based on the proposition that “The risks inherent in this [constrained liner] procedure are similar to those for total hip replacement surgery utilizing a [semi-constrained] class II device”. (p. 126)

Total hip replacement involves 2 components:

- (1) a stem whose distal part fits into the hollow canal inside the femur and whose proximal end is a spherical head that articulates with the acetabulum. According to Stedman’s Medical Dictionary (4<sup>th</sup> Ed.) the acetabulum is “a cup-shaped depression on the external surface of the hip bone, in which the head of the femur fits.” And,
- (2) an acetabular component, or metal shell with a polymer liner, that is fixed to the hip bone by cement or screws. The standard femoral and acetabular components, as well as the polymer liner, are class II devices.

In routine hip replacement, the acetabular liner is “semi-constrained.” “The semi-constrained liner relies on the soft tissue in the hip joint to stabilize the joint.” (p.3) But “in patients at high risk of dislocation due to a history of prior dislocation, bone loss, soft tissue laxity, neuromuscular disease, or intraoperative instability,” (p.6) a “constrained” liner may be indicated. “The constrained cup retains the ball of the femoral component by extending beyond a hemisphere and partially encasing it to provide joint stability.” (p.5)

Petitioner identifies “pain relief, restoration of function, and reduction in recurrence of dislocation” as important findings in “published experience with constrained hips [though the literature] relatively small in comparison to that of total hip arthroplasty [which is] to be expected given the rather limited patient population and indications for which this device is intended.” (p.11)

Petitioner places major emphasis on the constrained liner’s ability to avoid dislocation in patients who have a history of hip dislocation or who are otherwise at high risk of such an event: “It is important to realize that the primary goal was a stable hip with no additional dislocations.” (discussion of a journal article on the Osteonics Omnifit constrained liner, at p.27).

The literature presented (or summarized) in the petition relating to total hip arthroplasty, covers some 23,000 patients, for which dislocation rates are reported in the range of 1% to 6% of patients.

Only 2 articles present quantitative information in tabular form on the constrained liner, covering a total of 77 patients, all treated with one brand of constrained liner, the J&J S-ROM. (Anderson, et al, at Tab 10, and Lombardi, et al, at Tab 16).

Two other articles deal with the Osteonics Omnifit constrained liner, both by Goetz, et al, at Tab 13 (55 patients) and Tab14 (98 patients). One article (Tab 13) adduces pain data that petitioner finds “difficult to interpret”. (p.27) Goetz, et al, at Tab 14, include various percentages imbedded in text mainly devoted to providing details about particular cases.

Summary information on the experience of 137 patients with the Biomet Ringloc constrained liner are included at pages 3 1-3 7. I have not found the source of this information.

## ISSUES

1. Is a comparison of constrained-liner performance data to that of total hip arthroplasty data with respect to “pain relief, restoration of function, and reduction in recurrence of dislocation” a direct comparison of constrained versus semi-constrained performance – i.e. a comparison of the class III device to its class II analogue?

2. Is comparison of constrained and semi-constrained liner performance meaningful if the populations are inherently different? If not, to what can the constrained liner appropriately be compared?
3. There appear to have been no clinical trials of the constrained liner. The studies reported by petitioner are based on experience in orthopedic practice, without the benefit of formal protocols, written before clinical-trial commencement, that precisely define the intended population, establish diagnostic rules, standardize data elements, acquisition and processing, and delineate statistical endpoints. Are there no such clinical trials?
4. Recurrence rates are reported in the Anderson and Lombardi S-ROM papers represent rather disparate levels - 29% and 9%, respectively - which are above the 1% to 6% range in the total hip arthroplasty literature. One of the two Goetz articles on the Osteonics Omnifit reports a 3% dislocation rate (1 out of 38 patients with follow-up), which is within the total hip arthroplasty reported range. On p.33, petitioner reports a 6.6%, dislocation rate for the Biomet Ringloc constrained liner, which is an aggregation of an 11.3% rate for cases with surgery prior to December 26, 1996, and 3.6% for cases subsequent to that date.

Overall, the reported dislocation rates overlap with, but tend to be offset above, those for total hip arthroplasty: 3.6% to 29% for constrained liner, versus 1% to 6% for total hip arthroplasty.

Petitioner has not attempted to reconcile these diverse rates with the claim on p. 126 of similarity of risks associated with constrained and semi-constrained liners.

5. The issue of variation in recurrence rates across patient sub-populations (e.g. males versus females) does not seem to have been addressed.
6. The reported dislocation rates should be specific to the duration of follow-up time, and should take into account the variation in exposure time among patients. A statistical time-to-event model, or survival analysis, should be used to compare time-specific failure probabilities between comparison groups. Probability estimation done without

considering specific follow-up time is subject to inclusive bias. With just 2 exceptions, such methods were not used:

- (1) Anderson, et al, Tab 10, reporting on experience with the S-ROM, present on p.272 a “Survival curve of the constrained device”. It is not accompanied with any explanation of how it was computed, nor are any rates extracted from it. Precision of estimation is also not addressed.
  - (2) Schulte, et al, Tab 7, pages 236-238, present Kaplan-Meier curves on retention of cemented Charnley hip prostheses, but do not extract any rates from the curves.
7. Data have not been marshalled to make pain-relief comparisons of the 2 types of liners, nor comparisons of “restoration of function”.

**RECOMMENDATION.** Petitioner’s project amounted on-line computer searches (including MAUDE searches) and extraction of information from the documents that matched the search criteria. It did not extend to acquiring case-level data and carrying out statistical calculations of the kinds whose absence in the petition are noted above. I recommend that petitioner be encouraged to see if any data can be obtained and used to address the identified statistical issues.