

Research Article

Unstable total Hip Replacement. are Constrained Liners A Solution? Experience and Literature Review

Guillem Figueras Coll^{1*}, Marta Bonjorn Martí², Ramón Vives Planell³, Ernest Ros Montfort⁴, Ramón Serra Fernández⁵ and Chairman Joan Camí Biayna⁶

¹Guillem Figueras Coll, Orthopedics and Traumatology. Universitat Internacional de Catalunya. Spain

²Marta Bonjorn Martí, Orthopedics and Traumatology. Universitat Internacional de Catalunya. Spain

³Ramón Vives Planell, Orthopedics and Traumatology. Universitat Internacional de Catalunya. Spain

⁴Ernest Ros Montfort, Orthopedics and Traumatology. Universitat Internacional de Catalunya. Spain

⁵Ramón Serra Fernández, Orthopedics and Traumatology. Universitat Internacional de Catalunya. Spain

⁶Joan Camí Biayna, Orthopedics and Traumatology. Universitat Internacional de Catalunya. Spain

***Corresponding author**

Guillem Figueras, Fundació Althaia. C/Dr. Joan Soler 1-3, 08243 Manresa, Spain. Tel: 0034 - 93 875 9300; Email: guillem9279@hotmail.com

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Abstract

The purpose of this paper is to assess clinically and radiologically our experience with constrained acetabular components for the unstable hip following total hip replacement.

From July 2006 to August 2012 we retrospectively reviewed the clinical and radiographic outcome of 22 arthroplasties, in 20 patients. The mean age at surgery of constrained acetabular component was 73 years (range, 35 to 90 years) and the mean clinical and radiological follow-up period was 35 months (range, 3 to 73 months). Clinical assessment was performed by the Harris Hip Score and the SF-12.

The constrained acetabular device eliminated or prevented hip instability in all patients except in 3 hips who had new dislocation. The mean Harris hip score in the last evaluation was 74 points, and SF-12 was 27 points.

A constrained acetabular components are simple to use and provides satisfactory mid term results for the treatment of hip instability in primary and revision replacement in those at high risk of dislocation.

The potential for aseptic loosening requires evaluation by long term studies and bigger series.

INTRODUCTION

Dislocation is one of the most common complications in total hip arthroplasty, occurring after 0,4 - 7% of primary procedures and up to 19% of revisions. Various predisposing causes and associated factors have been identified. These include malposition of the components, previous surgery and revision THA, gluteal muscle deficiency, trochanteric nonunion, bone or cement impingement, soft-tissue imbalance, neuromuscular

disorders. Surgical options for treatment include revision the position of the components, trochanteric advancement, capsulorrhaphy, improvement of soft-tissue tensioning by increasing offset, augmentation of the acetabular lining, bipolar arthroplasty, insertion of a constrained cup mechanism, inverted cup prosthesis, Bousquet's acetabular component.

At our hospital constrained acetabular components have been used in four situations: [1] cases with no identifiable cause

of instability, [2] cases with surgical attempts at stabilization have failed, [3] cases with significant deficiency of soft-tissue attachments around the hip and [4] patients with neuromuscular disorders.

The use of constrained acetabular components has gained interest in the last 15 years with multiple short term papers reporting success rates of greater than 80%.

Some surgeons believe increased mechanical stresses inherent to these designs may predispose these hips to increased risks of wear, osteolytic processes, loosening and potential dissociation of the components with subsequent re-operation.

MATERIALS AND METHODS

From July 2006 to August 2012 we retrospectively reviewed the clinical and radiographic outcomes of 22 arthroplasties, in 20 patients, 8 women and 14 men. The right side was the predominant with 14 cases.

Of the 22 patients who were identified, 3 patients had been lost because they died for causes unrelated to the arthroplasty. In 18 hips the constrained component was implanted for the treatment of recurrent instability (Figure 1a and 1b), two hips was implanted because grossly deficient soft-tissue attachments were believed to be associated with a high risk for subsequent instability, and in two cases were indicated for neuromuscular disorder, West Syndrome.

The primary indications for total hip replacement were arthrosis in 13 cases and femoral neck fracture in 8 cases and, one case of comminuted per-trochanteric fracture.

The mean age at surgery was 73 years (range, 35 to 90 years) and the mean clinical and radiological follow-up period was 35 months (range, 3 to 73 months). Clinical assessment was



Figure 1a Preoperative X-ray of recurrent instability of total hip replacement.



Figure 1b Revision of acetabular component with constrained acetabular device.

performed by the Harris Hip Score and the SF-12. All radiographs were evaluated for evidence of loosening.

The surgical approach was posterolateral in 9 hips and anterolateral in 13. Including the initial arthroplasty, all patients had undergone at least one reconstructive operation on the hip prior to insertion of constrained cup. Table 1 provides an overview of the patient demographics and follow-up details. A constrained liner is a device consisting of a liner and reinforcing ring. The polyethylene liner fits into the acetabular metal shell and articulates with the femoral head. The articular surface opening of the constrained liner is reduced slightly to allow for mechanical capture of the femoral head. The constrained acetabular components used in our series consisted in constrained cementless acetabular component inserted in a press-fit fashion. The metal-back component was secured with three screws at least. In two hips a polyethylene constrained insert was cemented into a well-fixed cup. Four types of constrained acetabular liner were used in the study; The trilogy Acetabular System Constrained Liner (Zimmer) was used in 8 cases, the RingLoc II Constrained (Biomet Orthopedics) was used in 9 hips, one case with Smith & Nephew liner and one hip with Duraloc Constrained Liner (DePuy). Anteroposterior and lateral radiographs of the hip joint were revised to assess the position of the implant and look for signs of loosening or wear prosthesis. Acetabulum was divided into three zones (De Lee and Charnley zones) to evaluated the presence of radiolucent lines. Possible loosening was defined as the location of a radiolucent line occupying >50% but <100% of bone-component interface on any radiograph or the presence of a progressive radiolucent line.

RESULTS

The constrained acetabular device eliminated or prevented hip instability in all patients except in 3 hips who had new dislocation. The mean Harris hip score in the last evaluation was 74 points (range 33-96), and SF-12 was 27 points (range 12-48).

There were 2 cases of disassembly and one case of dislocation of the hip components (Figure 2). All of them had a deep infection. Three hips more needed a superficial debridement. Additional

complications in the remaining cases included heterotopic ossification (two hips), urinary infection (three hips). There was no deep venous thrombosis and no sciatic nerve palsy.

There were three cases with radiolucent lines, two in zone I and one in zone II, but only one of them was revised. This case was revised because radiolucent lines were progressive.

DISCUSSION

Recurrent instability is often multifactorial and frequently is not associated with a clearly identifiable cause [1,2]. It has been estimated that surgical treatment of recurrent instability is required after approximately 1% of total hip arthroplasties [3,4,5]. Chronic instability occurs in up to 33% of dislocations [6,7,8]. Before the use of constrained liners, there were no reliable solutions to dislocation arising from inadequate soft tissues, a deficient abductor mechanism, or neuromuscular disorders [9].

The use of constrained acetabular components has gained interest over the past decade, with multiple short-term studies reporting success rates of greater than 80% [5]. The risk of dislocation following revision is increased in comparison to primary procedures. As a result of this high failure rate for these patients, the use of a constrained acetabular component has increased [4,5]. William JT Jr et al. analyzed eight papers including 1199 hips in 1148 patients with a total mean follow-up of 51



Figure 2 Dislocation of constrained acetabular component because of disassembly of femoral head and constrained liner.

months. The mean rate of dislocation following revision with a constrained liner was 10% and the reoperation rate for reasons other than dislocation was 4% [5]. In a retrospective study involving clinical and radiographic outcome of 110 arthroplasties using a constrained acetabular component the device eliminated or prevented hip instability in more than 98% of cases [2]. Goetz et al., showed fifty-four (96%) of fifty-six hips stable after insertion a constrained acetabular device [10]. A review of the literature of use of constrained acetabulars components are shown in Table 2.

The management of hip instability with a cemented or uncemented, constrained acetabular component is useful when there is no single identifiable cause of instability but, there are a number of potential problems with the use of them. [1,2,11] The use of cemented component include premature acetabular loosening, rapid polyethylene wear, decreased range of motion [1,9,6,12,13]. However the use of a cemented liner eliminates backside wear and the direct access of wear particles to the acetabular bone stock, which may help to reduce the potential for acetabular osteolysis [1].

Khan et al. analyzed 107 hips in 104 patients treated with the uncemented constrained cup. There was an inverse association between the number of screws used to secure the cup and subsequent loosening, which almost reached statistical significance. Cups with no screws or a single screw were more likely to loosen. There was no significant association between component migration or loosening and age, sex, cup size, the use of bone graft, or position of the shell in the vertical and horizontal planes [14]. Our point of view is that use of bone graft, hinders the well-fixed cup, and vertical position of the constrained shell brings on loosening component. Bakker et al. have published that implantation of the acetabular component in the correct orientation is critical in preventing impingement and subsequent stresses on the interfaces of acetabular reconstruction [1].

Complications of constrained acetabular components can be divided into 3 categories. The first category is directly related to the constraining mechanism such as dislocation, head dissociation from the stem, liner dissociation from the acetabular device. The second category is related to increased constraint such as aseptic

Table 1: Demographic Information.

| Variable | Measure |
|--------------------------|-------------------|
| Cases (hips) | 22 |
| Patients | 20 |
| Female patient | 8 (36%) |
| Left hips | 8 (36%) |
| Average age at surgery | 73 (35-90) months |
| Average follow-up | 35 (3-73) months |
| Posterior approach | 9 (40%) |
| Average SF-12 | 27 (12-48) |
| Average Harris Hip Score | 74 (33-96) |

Table 2: Clinical outcomes of constrained acetabular components.

| Author | Year | Hips/ patients | Follow-up (months) | Reoperation rate (%) |
|--------------------|------|-------------------|-----------------------|-------------------------|
| Lombardi et al. | 1991 | /55 | 30 | 9 |
| Anderson et al. | 1994 | 21/21 | 31 | 29 |
| Goetz et al. | 1998 | /101 | 51 | 16 |
| Bremer et al. | 2003 | 101/98 | 124 | 6 |
| Shapiro et al. | 2003 | 87/84 | 58 | 2,4 |
| Shrader et al. | 2003 | 110/109 | 38 | 8,1 |
| Callaghan et al. | 2004 | 31/30 | 47 | 6,4 |
| Berend et al. | 2005 | 755/720 | 42 | 17,5 |
| Della Vaile et al. | 2005 | 55/51 | 24 | 16 |
| Mcarthy et al. | 2005 | 39/38 | 46 | |
| Rady et al. | 2010 | 15/15 | 26 | 6,6 |
| Figuera et al. | 2012 | 22/20 | 35 | 9 |

loosening and osteolysis, and periprosthetic fracture. The third category includes infection, deep vein thrombosis, sciatic palsy and periprosthetic fracture [5,15,11].

Pattyn C. et al. recommend judicious use of constrained devices because of high failure rate (26%) and consideration of alternative options such as the use of large-diameter metal-on-metal bearings [15,16]. A current study with minimum 10-year follow-up of 667 hips, the recurrent dislocation rate was 17,5% [15]. The failure rate directly related to the constraining device, including dislocation, was 18,6%. They conclude that use these components do not appear to decrease the rate of dislocation from the 19% rate previously described for revision surgery [13].

Great concerns exist regarding the quality and thickness of the polyethylene used in these devices. For example the liners used in the majority of cases were frequently coupled with 32 femoral heads resulting in a polyethylene thickness of 3.0 to 5.0 mm [15]. Similar catastrophic wear has been referenced by others [17,18]. Newer products with improved polyethylene quality, manufacturing, and sterilization techniques, in addition to novel constraining mechanisms, may provide increased durability, improved longevity, and decreased wear [15,19].

Regarding the radiolucencies many of the hips that had had multiple operations frequently had associated acetabular bone deficiencies. Some of the radiolucencies that were observed may have been a consequence of this factor rather than a result of any effect caused by the constrained acetabular insert [2].

In cases of hip instability with a well-fixed cementless acetabular shell, cementing an acetabular liner into secure attached cup could be a great solution [20]. A 2-mm cement mantle was adequate for fixation. However Saphiro et al. and Su et al. do not recommend this mode of fixation because they reported several hips which required revision for aseptic loosening before 20 months of follow-up [9,6].

Other designs of device to avoid the dislocation have been found in literature. We have mentioned these we believe more relevant. The first is the constrained tripolar design which consists of a femoral head that snaps into a polyethylene shell with a polished cobalt-chrome backing, which in turn articulates within an other polyethylene liner. This bipolar construction is then snapped into a Osteonics (Stryker) acetabular shell [5,9,21]. The second device is a custom-made constrained construct which consists of the application of an inverted cup over the femoral neck or head, the cup being fixed to the acetabular insert with screws [22]. The third model is the Bousquet's acetabular component that is an steel cup covered with alumina, impacted without cement. The polyethylene component is free in the cup and retentive on the femoral head [23].

CONCLUSION

A constrained acetabular components are simple to use and provides satisfactory mid term results for the treatment of hip instability in primary and revision replacement in those at high risk of dislocation. They are a reasonable and reliable method for restoring stability at the site of a complex unstable hip replacement.

The potential for aseptic loosening requires evaluation by

long term studies and bigger series.

REFERENCES

1. Bakker-Dyos J, Moran M. Management of hip instability with a cemented, constrained acetabular component. *Hip Int.* 2012; 22: 254-260.
2. Shrader MW, Parvizi J, Lewallen DG. The use of a constrained acetabular component to treat instability after total hip arthroplasty. *J Bone Joint Surg Am.* 2003; 85-85A: 2179-83.
3. Berry DJ. Unstable total hip arthroplasty: detailed overview. *Instr Course Lect.* 2001; 50: 265-274.
4. Rady AE, Asal MK, Bassiony AA. The use of a constrained cementless acetabular component for instability in total hip replacement. *Hip Int.* 2010; 20: 434-439.
5. Williams JT Jr, Ragland PS, Clarke S. Constrained components for the unstable hip following total hip arthroplasty: a literature review. *Int Orthop.* 2007; 31: 273-277.
6. Shapiro GS, Weiland DE, Markel DC, Padgett DE, Sculco TP, Pellicci PM. The use of a constrained acetabular component for recurrent dislocation. *J Arthroplasty.* 2003; 18: 250-258.
7. Morrey BF. Instability after total hip arthroplasty. *Orthop Clin North Am.* 1992; 23: 237-248.
8. Ali Khan MA, Brakenbury PH, Reynolds IS. Dislocation following total hip replacement. *J Bone Joint Surg Br.* 1981; 63-63B: 214-8.
9. Su EP, Pellicci PM. The role of constrained liners in total hip arthroplasty. *Clin Orthop Relat Res.* 2004; : 122-129.
10. Goetz DD, Capello WN, Callaghan JJ, Brown TD, Johnston RC. Salvage of a recurrently dislocating total hip prosthesis with use of a constrained acetabular component. A retrospective analysis of fifty-six cases. *J Bone Joint Surg Am.* 1998; 80: 502-509.
11. Yang C, Goodman SB. Outcome and complications of constrained acetabular components. *Orthopedics.* 2009; 32: 115.
12. Khan RJ, Fick D, Alakeson R, Haebich S, de Cruz M, Nivbrant B. A constrained acetabular component for recurrent dislocation. *J Bone Joint Surg Br.* 2006; 88: 870-876.
13. Lombardi AV Jr, Mallory TH, Kraus TJ, Vaughn BK. Preliminary report on the S-ROM constraining acetabular insert: a retrospective clinical experience. *Orthopedics.* 1991; 14: 297-303.
14. Khan RJ, Fick D, Alakeson R, Li MG, Nivbrant B, Wood D. The constrained acetabular component for hip instability. *J Arthroplasty.* 2007; 22: 377-382.
15. Berend KR, Lombardi AV Jr, Mallory TH, Adams JB, Russell JH, Groseth KL. The long-term outcome of 755 consecutive constrained acetabular components in total hip arthroplasty examining the successes and failures. *J Arthroplasty.* 2005; 20: 93-102.
16. Pattyn C, De Haan R, Kloock A, Van Maele G, De Smet K. Complications encountered with the use of constrained acetabular prostheses in total hip arthroplasty. *J Arthroplasty.* 2010; 25: 287-294.
17. Dearborn JT, Murray WR. Arthopor 2 acetabular component with screw fixation in primary hip arthroplasty: a 7- to 9-year follow-up study. *J Arthroplasty.* 1998; 13: 299-310.
18. Engh CA Jr, Hopper RH, Engh CA, McAuley JP. Wear-through of a modular polyethylene liner: four case reports. *Clin Orthop Relat Res.* 2001; : 175-182.
19. Burroughs BR, Golladay GJ, Hallstrom B, Harris WH. A novel constrained acetabular liner design with increased range of motion. *J Arthroplasty.* 2001; 16: 31-36.

20. Callaghan JJ, Liu SS, Schularick NM. Shell retention with a cemented acetabular liner. *Orthopedics*. 2009; 32.
21. Callaghan JJ, O'Rourke MR, Goetz DD, Lewallen DG, Johnston RC, Capello WN. Use of a constrained tripolar acetabular liner to treat intraoperative instability and postoperative dislocation after total hip arthroplasty. *Clin Orthop Relat Res*. 2004; 429: 117-123.
22. Harake R, Colen S, Mulier M. Inverted cup prosthesis to treat recurrent hip dislocation in frail elderly patients. *Ortop Traumatol Rehabil*. 2012; 14: 179-182.
23. Leclercq S, el Bliidi S, Aubriot JH. [Bousquet's device in the treatment of recurrent dislocation of a total hip prosthesis. Apropos of 13 cases]. *Rev Chir Orthop Reparatrice Appar Mot*. 1995; 81: 389-394.

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