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Original Article

Radiographic evaluation of 19 patients with Paprosky 3A and 3B submitted to acetabular review with trabecular metal wedge

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ABSTRACT

Objective: This study is aimed at evaluating the fixation of trabecular metal wedges in patients who underwent revision of total hip arthroplasty with large acetabular bone defects.
Methods: The radiographs of 19 patients (21 hips), who underwent revision of total hip arthroplasty using trabecular metal wedges from September 2010 to December 2014 were evaluated. This study included only cases of Paprosky 3A and 3B. Preoperative and postoperative images were analyzed. Non-fixation of the implant was defined by the presence of angular variation of the component higher 10 degrees or displacement greater than 6 mm. Patients with follow-up times of less than 24 months or who did not attend the last two appointments were excluded from the study.
Results: The mean follow-up time was 39.4 months (25–61). Fixation was achieved in all cases despite its complexity. There was only one case of dislocation that was treated with open reduction. One case developed infection, and was surgically approached on two occasions, with extensive debridement and intravenous antibiotics following protocol, with good evolution.
Conclusion: The implanted trabecular metal wedges showed excellent results in the short- and medium-term and may represent another option in the reconstruction of large acetabular defects, sometimes replacing bone reconstruction that uses bone tissue banks or autologous graft.

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Avaliação radiográfica de 19 pacientes Paprosky 3A e 3B submetidos à revisão acetabular com cunha de metal trabeculado

Palavras-chave:
Artroplastia de quadril
Acetábulo
Próteses e implantes

RESUMO

Objetivo: Avaliar a fixação das cunhas de metal trabeculado em pacientes submetidos a revisão de artroplastia do quadril com grandes defeitos ósseos acetabulares.
Métodos: Foram avaliadas as radiografias de 19 pacientes, ou 21 quadris, submetidos a revisão de artroplastia do quadril com cunha de metal trabeculado de setembro de 2010 a dezembro de 2014. Foram incluídos somente os casos Paprosky 3A E 3B. Exames de imagem pré-operatórios e pós-operatório foram analisados. A não fixação do implante foi definida pela presença de variação angular do componente superior a 10 graus ou deslocamento superior a 6 mm. Pacientes com tempo de seguimento inferior a 24 meses ou aqueles que não compareceram às duas últimas consultas foram excluídos.
Resultados: O tempo de seguimento médio foi de 39,4 meses (25-61). A fixação foi alcançada em todos os casos, apesar da complexidade. O único caso de luxação foi submetido a redução aberta. Um caso evoluiu com infecção, foi abordado cirurgicamente em dois momentos, com amplo desbridamento e uso de antibiótico venoso, conforme protocolo, e apresentou boa evolução.
Conclusão: O implante em cunha de material trabeculado apresentou resultados excelentes em curto e médio prazos, pode ser mais uma opção nas reconstruções dos grandes defeitos acetabulares, por vezes substitui a reconstrução óssea com o uso de banco de ossos ou enxerto autólogo.

Introduction

Hip surgery reviews have become increasingly common in hip specialist practices, mainly associated with an exponential increase in total hip arthroplasty in Brazil and worldwide. It is estimated that 250,000 primary arthroplasties and 50,000 revision arthroplasties are performed annually in the United States.[1] Acetabular revision surgeries are generally classified according to the remaining bone stock, and the complexity of this procedure is a major challenge even for the more experienced surgeons (Fig. 1).

When analyzing the history of revision surgery, the advancement in the area of acetabular defect filling materials has been extraordinary. Based on postoperative questionnaires, the clinical results have also shown a substantial improvement.

The preoperative understanding of bone defects is paramount for surgical planning. Among the several classifications in the literature, that by Paprosky et al.[2] is one of the most used. In general, this classification assesses the presence or absence of osteolysis in three points: the ischium, the Kohler line, and the superior wall of the acetabulum.

The literature presents several options for the treatment of acetabular defects, each with positive and negative aspects. The technique involving acetabular reconstruction with trabecular metal is relatively new; its results have been more frequently published in recent years, especially in the complex Paprosky 3A and 3B defects, in order to re-establish the center of rotation of the hip.[3–5]

Trabecular metal has been increasingly used in major hip surgery reference centers, both as an acetabular revision component, and as an option to fill acetabular defects. The high failure rate of traditional porous components when used in revision surgery can be explained not only by their physical and mechanical characteristics, but also by the difference in porosity when compared with trabecular metal, which in the latter can reach 75–80%.[6] This feature is very interesting, as it provides a much superior bone growth into the porosities when compared with traditional implants (Fig. 2).

The trabecular metal wedge comes in several sizes and three shapes, which allows the filling of a wide diversity of bone defects.

This study is aimed to assess the fixation of trabecular metal implants in patients classified as Paprosky 3A and 3B who underwent total hip arthroplasty revision.

Methods

Between September 2010 and December 2014, 258 hip arthroplasty revisions were performed at the Hospital of Traumatology and Orthopedics. Of these, 19 patients (21 hips) were classified as Paprosky 3A or 3B, and underwent the trabecular metal wedge procedure aiming to reconstruct the bone defects. Follow-up time of less than 24 months and absence from the last two outpatient visits were the exclusion criteria.

The mean age of the patients was 56.8 years (35–76); 12 were males and seven, females. The mean follow-up time was 29.3 months (range: 14–55). The posterolateral access route was used in all patients. All patients underwent femoral component revision. In all cases, five fragments were collected for bacterial culture and antibiogram.

Fig. 1 – Loosening of the acetabular component after reconstruction with Burch-Schneider acetabular reinforcement ring (3A defect).

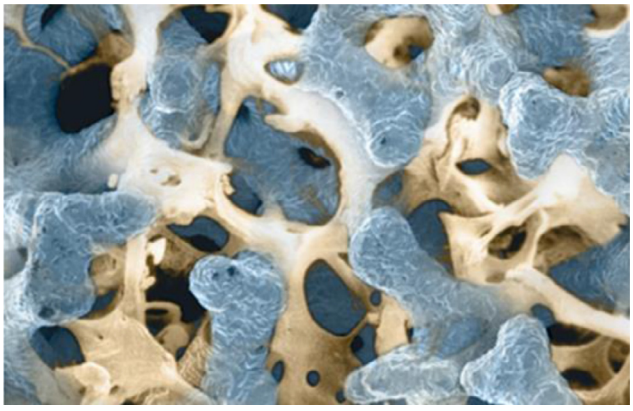

Fig. 2 – Electronic photomicrography demonstrating bone growth in the porous tantalum structure (Zimmer.com).

Patients were classified according to Paprosky et al.[2] The results were analyzed using Student's *t*-test and considered significant when $p < 0.05$.

The criteria for the use of the trabecular metal wedge was lack of coverage (contact with the host bone) over 40%,[7] or cases in which the initial stability of the component was not obtained and the wedges were used to stabilize the reconstruction system. In all cases, bone cement was used at the interface between the wedges, as well as between the wedges and the trabecular acetabular component.

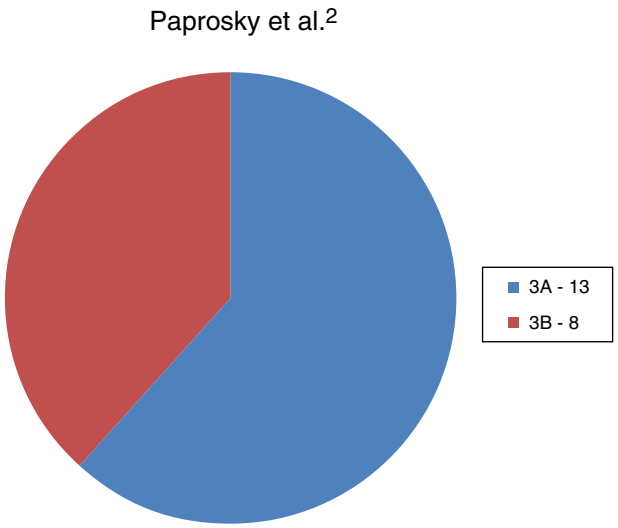

Fig. 3 – Division of cases studied according to Paprosky's classification.

In six patients under the age of 55 years, bone graft was used to restore the bone stock. In one case, an autologous graft was combined with bone tissue bank, and in five cases, only autologous graft from the posterior iliac crests was used.

No patients required postoperative drains. Patients were prescribed prophylactic subcutaneous low molecular weight heparin for 30 days.

The outpatient follow-up was performed according to the medical service's protocol, at three weeks, three months, six months, and one year postoperatively, and then annually thereafter. Patients were clinically evaluated according to the criteria of Merle D'Aubigné and Postel,[8] and radiologically with panoramic views of the pelvis and hip in anteroposterior and lateral views. With these complementary exams, osseointegration of the acetabular component was assessed according to the criteria set by Moore et al.[9] The presence of three or more has a positive predictive value of 96.9%. Wedge osseointegration failure was demonstrated when an angular variation greater than 10 degrees or component displacement greater than 6 mm were observed.[10] The position of the center of rotation in the pre- and postoperative period was assessed and compared with that of the contralateral hip.

Results

The mean number of previous surgeries was 1.3 (1–3), and the mean time since the last procedure was 10.68 years (6–17). Fig. 3 presents the division of cases studied according to the classification of Paprosky et al.[2]

The center of rotation on preoperative radiographs was located at a mean of 38 mm (28–59) when compared with the contralateral side. In six cases, this parameter was not assessed due to contralateral arthroplasty (Fig. 4). In the postoperative period, two hips presented a center of rotation

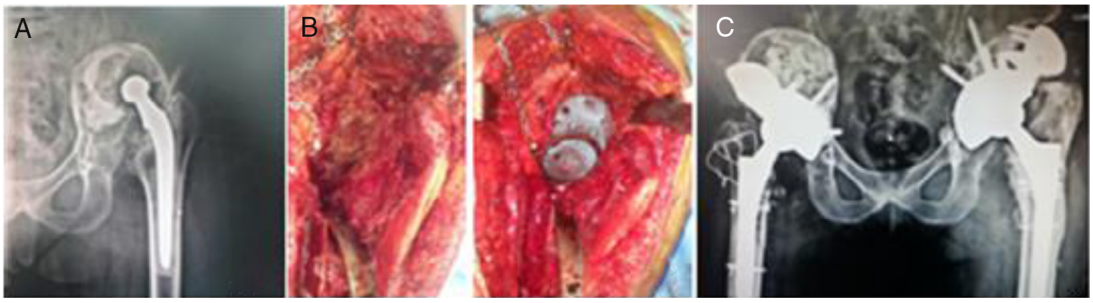

Fig. 4 – Bilateral revision of total hip arthroplasty. A, preoperative radiograph of the left hip showing severe acetabular defect (Paprosky 3B); B, perioperative imaging showing the use of trabecular metal wedge; C, panoramic postoperative radiograph of the pelvis.

greater than 20 mm; however, these cases presented good clinical evolution.

All bacterial cultures collected during the procedures were negative.

Clinically, the patients were evaluated by the criteria of Merle D'Aubigne and Postel,[8] evolving from 6.67 points in the preoperative to 14.83 in the postoperative period. Student's *t*-test indicated that this difference was statistically significant ($p < 0.0001$).

The mean acetabular component size was 62 (54–74). An acetabular component coated with trabecular metal was used in all cases. All three types of wedges (semicircular, column support, and chock-shaped) were used; they are shown in Fig. 5.

The criteria for wedge instability were not observed, even in those that were not secured with screws, and used to promote the stability of the system in acetabular reconstruction (Fig. 6).

All acetabular domes presented three or more fixation criteria. In all cases, 32 mm femoral heads were used.

Regarding complications, one patient presented postoperative dislocation and underwent surgical reduction. Another patient developed acute infection and underwent two surgical procedures for debridement and intravenous antibiotic application in accordance with the medical service protocol, presenting a satisfactory evolution. None of the complications resulted in loosening or instability of the acetabular component or of the trabecular metal wedge.

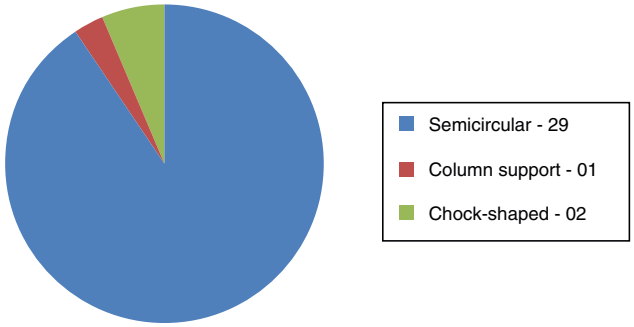

Fig. 5 – Types of wedges used for acetabular reconstruction.

Discussion

The correct understanding of bone defects following total hip arthroplasty is a primary pillar of joint reconstruction. The increase in the number of revisions is directly proportional to the increase in the number of primary arthroplasties performed worldwide, especially in young patients. The various materials and new techniques available direct toward new ways of managing different acetabular bone defects. Several surgical options have been described, such as impacted grafts,[11] antiprotrusion rings,[12–15] oblong components,[16,17] structured grafts,[18] large components or jumbo cups,[19] and acetabular components associated with trabecular metal wedges.[20–22]

The literature indicates significant failure rates in reconstructions with structured graft, which are attributed to the slow bone incorporation, which in turn leads to the instability of the acetabular component.[23] Oblong prostheses tend to restore the center of rotation. Nonetheless, the literature describes a high failure rate.[24] Reconstruction with antiprotrusion rings is an excellent option. However, some studies report a failure index associated with non incorporation of the graft, failure of the implant in promoting adequate biological fixation, and the need for a bone tissue bank for this procedure.[15] Regis et al.[25,26] reported that 9.23% of complications were related to aseptic loosening or breakage, higher in type 3B defects. A study published in 2012[15] presented a survival rate of 72.2% after a minimum follow-up of 10 years. Beckmann et al.[27] published a comparative study between an antiprotrusion ring and trabecular metal that demonstrated a statistically lower rate of loosening with trabecular metal wedge when compared to the antiprotrusion ring in all degrees of acetabular defects, with an apparently greater benefit in severe cases.

The use of trabecular metal wedges has become attractive in revisions with large bone defects, mainly regarding the stability obtained in the reconstruction and the versatility in its use,[28] the nonrelation with graft resorption, and the absence of donor area morbidity or the need for a bone tissue bank as a source for filling bone defects.[27,29]

In 2006, Sporer and Paprosky[21] published a series of 28 hips, classified only as Paprosky 3A or 3B, and did not report aseptic loosening. Borland et al.[3] analyzed 24 patients after a mean follow-up of five years and reported one case of failure due

Fig. 6 – Total hip arthroplasty revision. A, preoperative radiography showing severe acetabular defect (Paprosky 3B); B, perioperative photo showing the acetabular reconstruction with the aid of trabecular metal wedge (note the absence of screw fixation of the intermediate wedge); C, postoperative radiography.

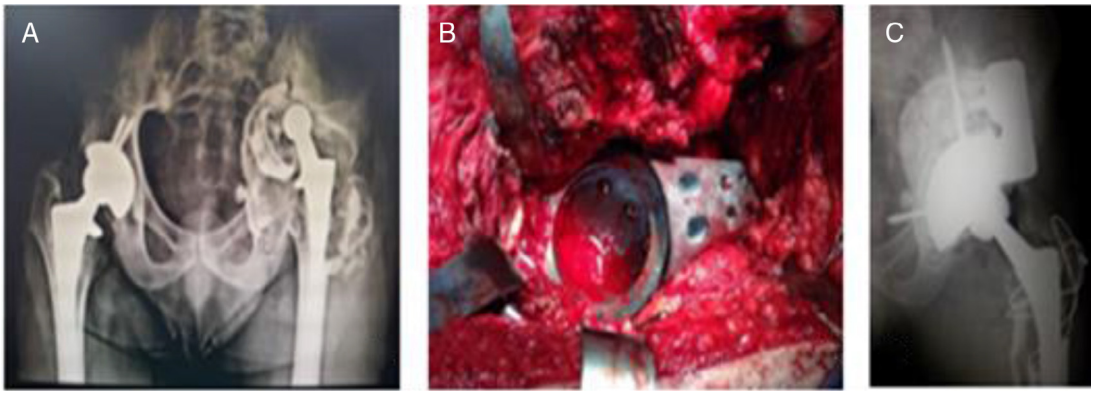

Fig. 7 – Total left hip arthroplasty revision with acetabular reconstruction. A, preoperative radiograph showing severe acetabular defect on the left (Paprosky 3B); B, perioperative imaging showing the use of chock-shaped column support trabecular metal wedge; C, panoramic postoperative radiograph of the pelvis.

to wedge rupture, which required a second revision. In 2015, Whitehouse et al.[30] observed a wedge survival rate of 92% in ten years of follow-up. In 2009, Siegmeth et al.[22] published a retrospective study of 37 patients with two cases of aseptic loosening, both of which were classified as 3A. Van Kleunen et al.[31] evaluated 97 patients who underwent this technique, and did not report this complication. Weeden et al.[32] analyzed 43 patients, only 3A and 3B defects, and reported a 98% survival rate in 2.8 years of follow-up. Lakstein et al.[33] reported an 8% failure rate in a four-year follow-up with the tantalum acetabular component when support/stability wedges were not used in contact failures greater than 50%. The present study assessed 19 patients, with a mean follow-up time of 39.4 months, and found a wedge fixation rate of 100% according to radiographic criteria.

According to Makinen et al.,[24] the clinical outcome is directly related to preoperative bone loss. Borland et al.[3] reported a significant improvement in the WOMAC ($p < 0.0001$) and SF-36 scores ($p < 0.05$). Siegmeth et al.[22] reported that the vast majority of patients presented a significant quality of life improvement. Grappiolo et al.[4] reported a Harris Hip Score of 40 preoperatively, *vs.* 90.5 postoperatively. Hasart et al.[34] assessed only patients with Paprosky 3A and 3B defects, using the evaluation criteria of Merle D'Aubigne and Postel,[8] and reported an improvement from 6 to 13 points in the postoperative period. Similar increments to those found in the literature were observed in the present patients, with a preoperative mean of 6.67 *vs.* 4.83 in the postoperative period; the best parameter was improvement of pain.

In the present study, a bone graft was used in six cases, all younger than 55 years of age, in order to restore the lost bone stock (Fig. 7). Borland et al.[3] used a similar technique in 24 patients, with a mean follow-up of five years and graft incorporation. Gunther et al.[35] evaluated 44 patients, with a mean follow-up of 38.8 months, and did not observe migration or loosening of implants with bone graft associated with trabecular metal wedges.

The improvement of the center of rotation is described as paramount for improvement in gait ability in the postoperative period, due to a better conditioning of the abductor muscles; it also causes less wear on the bearing surface and present a lower rate of aseptic loosening.[36,37] Abolghasemian et al.[10] reported improvement in the location of the center of rotation in 79.4% of the hips. Siegmeth et al.[22] reported improvement in 91% of cases; one of the three cases in which the center of rotation was greater than 35 mm evolved with wedge loosening and underwent a second revision. Callado et al.[38] reported a mean improvement in the center of rotation of 17 mm; in the preoperative period, 55.5% of the cases were above 35 mm. In the present study, the center of rotation was located 38 mm higher than the contralateral side; 77.7% of the cases measured in the pre-operative period were above 35 mm. In the postoperative period, two cases remained with a center of rotation greater than 20 mm, without

clinical and radiographic repercussion until the last outpatient evaluation.

As complications, in the present study there was one case of dislocation and one case of infection treated with surgical debridement and venous antibiotic. Until the last follow-up assessment, none of the complications had led to loosening of the components. The authors believe that the case of dislocation was related to a patient who had been bedridden for almost two years while awaiting the procedure; this patient had a history of two previous procedures and severe impairment of the abductor muscles. The patient who developed acute infection was in his second surgery and had been diagnosed with severe rheumatoid arthritis. Callado et al.[38] reported one case of infection in 23 Paprosky 3B cases. Van Kleunen et al.[31] reported an infection rate of 8.2% in 97 cases. In their series, Siegmeth et al.[22] reported a 5.4% rate of complications. Borland et al.[3] reported no complications in their series. The complication rate observed in the present study is consistent with the literature for such a complex sample.

Conclusion

The use of the trabecular metal wedges in revision surgeries for cases with severe bone defects (Paprosky 3A and 3B) present good clinical results and high survival in the short- and medium-terms, representing an alternative in complex joint reconstructions.

Conflicts of interest

The authors declare no conflicts of interest.

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