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Original article

Two-stage revision after total knee arthroplasty

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Summary. *Background and aim of the work:* Periprosthetic knee infection is a complication associated with prosthetic failure; incidence change from 0,4-2% of primary total knee replacement and 5,6% in revisions; incidence is increasing over the years. Two-stage revision is the technique used in chronic infection. Aim of the work is to check success rate in our data. *Methods:* We analyzed retrospectively data of patients who undergone two stage revision surgery between 01/01/2010 to 31/12/2015. We made a clinical and radiological control after 1, 3, 6, 12, 24 months and we evaluate the outcome in December 2016. *Results:* Between 2010 and 2015 we treated 45 patients with two-stage revision. Mean follow-up was 3,4 years. Success rate is 89,9%. We had failure in 5 patients: everyone had knee surgery before first knee arthroplasty and Charlson Comorbidity Score was greater then 4 in 4 cases. *Conclusions:* Two stage revision can be considered a successful treatment in chronic periprosthetic knee infection. It has an optimal success rate, but it has some disadvantages as joint stiffness and pain in the interval between stages. This is a technique with two major surgery procedure with associated morbidity, discomfort, cost and prolonged stay in hospital. (www.actabiomedica.it)

Key words: knee, periprosthetic, infection, two-stage, revision

Introduction

Prosthetic joint replacement are nowadays one of the most common operations in elective orthopedic surgery and we expect an increasing number of joints replacement due to the increasing age of the population (1). Culliford et al. estimate that the number of total knee arthroplasty (TKA) will increase of 160,18% from 2010 to 2035 in UK (2); similarly in USA according to the prevision of Kurtz et al. the number of TKA will increase of 673% from 2005 to 2030 (3).

There is an improved good outcome about the TKA over the years, with a percentage of revision of 4% in Sweden and 6% in Australia (4-6). According to the increasing age of the population, is natural to think that also the number of knee revisions will increase over the years (3). The introduction on national joint registries allow having information of prosthesis survey.

The most common causes of implant failure and need of revision are instability, mechanical loosening, malposition of prosthesis, dislocation, polyethylene wear, periprosthetic fractures and infection (7). The rate of infection in knee arthroplasty ranges from 0,4% to 2% in primary total knee replacement and 5,6% in revisions (8). Obviously, the absolute number of prosthesis joint infection (PJI) is increased and we expect that will increase again in the future because of the growing number of primary joint replacement. According to Kurtz et al. not only the absolute number of the PJI grows but also the percentage over the total primary implants. The incidence of PJI in knee arthroplasty increased from 2,05% to 2,18% from 2001 to 2009 (3). But in the series of Tsaras et al., they didn't register an increase of the number of PJI in 40 years of observation in a population of Minnesota (9).

There has been an improvement in the prevention measures but on the other side there is a registration of increasing risk factors depending on the patient's comorbidity according with their rising of mean age.

According to the time of presentation, in literature we distinguish the PJI into early (<3 months after surgery), delayed (3-24 months) and late infections (>24 months) (7, 10) but, according to recent work, we prefer to define early infections those which occurs before 4 weeks (11, 12). The most frequent agents are Gram positive cocci, S. aureus and coagulase-negative Staphylococci, while Streptococci and Enterococci are less frequent (7, 13).

Management of PJI depends on time of infection and consequently on the phase of maturation of the biofilm: in early PJI when biofilm is not mature we can do debridement, antibiotics and implant retention (14, 15). Even if there is a recent trend versus a one stage revision, in delayed and late PJI, when biofilm is mature, the most frequent approach is the two-stage revision, introduced for the first time by Insall et al. in 1983 (16, 17).

Materials and methods

We analyzed retrospectively data of patients who undergone two-stage revision surgery between 01/01/2010 to 31/12/2015. After the diagnosis of chronic periprosthetic infection, first surgery consisted in removing prosthesis and positioning a cemented articular spacer. We did in all of case medial parapatellar approach. All the surgery was made by the same surgeon. Recently, before arthrotomy we do leucocyte esterase test to confirm or exclude infection (18). During surgery, we collect three simple of periprosthetic tissues which are processed for intraoperative frozen section analysis: according to Mirra's criteria (19), we consider infection if polymorph-nuclear leukocyte number is more than 5 per 40X field (20). Furthermore, we collected multiple samples of tissue for microbiological cultures and prosthesis components are processed with sonication before culture. According to infectious disease clinician's indications, patients immediately started the antibiotic treatment, normally with Daptomycin (at least 8 mg/kg/day) and Rifampicin (10 mg/kg/day once a day; maximum of 900 mg/day). Piperacillin/Tazobactam were added if risk factors for Gram-negative bacteria were present (diabetes or relapsing urinary tract infection). This therapy continued until the results of microbiological cultures, with optimization of dosage according to therapeutic drug monitoring (TDM) and frequent blood tests for toxicity. Specific antimicrobical therapy was then started as soon as microbiological cultures were ready. This last therapy was continued for a mean of 6-8 weeks monitoring effectiveness and toxicity with blood exams. We followed these patients together with infectious disease clinician. At the end of the antibiotic therapy and in particular when no signs of infection were present, patients were ready for the second surgery (reimplantation). During second surgery, we proceed as in the first time with intraoperatory frozen section and histological examination and microbiological cultures of multiple samples of tissue. Spacer block is processed with sonication before culture. If we found less than five polymorph-nuclear leukocytes per high power field, we proceeded with implant revision arthroplasty. Instead, we replaced the spacer with an another one. After surgery, we started again an empiric antimicrobical therapy waiting the results of cultures. If no bacteria had grown, we stopped antibiotic therapy and we discharged patient. Now, the follow up was the same of primary implant surgery. We made a clinical and radiological control after 1, 3, 6, 12, 24 months and we evaluate the outcome in december 2016.

Results

Between 2010 and 2015 we treated 45 patients with two-stage revision. 21 patients were female and 24 male. Mean age was 73,3 years. Mean follow-up was 3,4 years. We have 5 failure, so success rate was 89,9%. In 6 patients we did quadriceps snip, in 18 patients we did tibial tubercle osteotomy. We used in 10 cases sleeves and in 22 cases tibial and/or femoral augments. In 12 cases cultures were negative; we found in 15 patients Staphilococcus spp. (in 9 patients methicillin-resistant Staphylococcus aureus), in 5 patients Streptococcus spp., in 8 patients Escherichia coli, in 3 patients Pseudomonas aeruginosa, in 2 patients Ente-

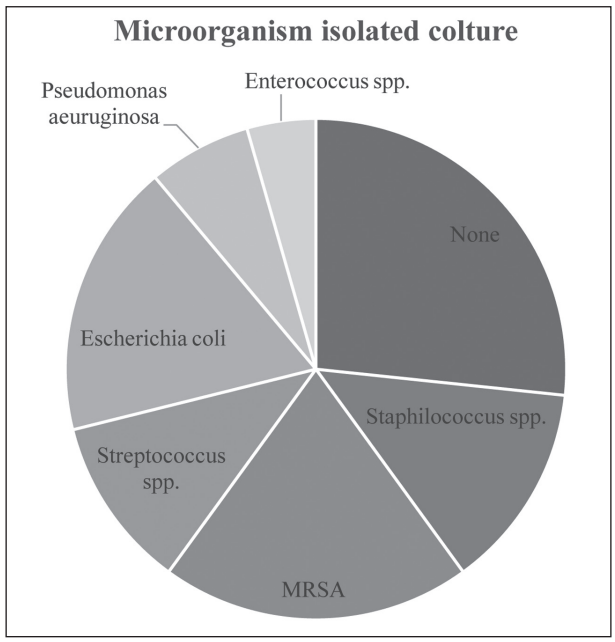

Figure 1.

Table 1

Microorganism isolated colture	Value
None	12
Staphilococcus spp.	6
MRSA	9
Streptococcus spp.	5
Escherichia coli	8
Pseudomonas aeuruginosa	3
Enterococcus spp.	2
Polimicrobical infection	15

rococcus spp., in 15 cases we had polymicrobial infection (Fig. 1, Tab. 1).

In failure cases, all patients had important comorbidity. Charlson Comorbidity Score was 4 or more in four patients and 2 in one patients. According to Baek et al. (21), patients with Charlson Comorbidity Score more than 4 are at 116% increased risk after TKA compared to those with a score of 0. All the 5 patients had an other knee surgery before first arthroplasty: femoral osteotomy, two osteosynthesis of polyfragmentated tibial fracture, realignment of the extensor mechanism, patella fracture. About leucocyte esterase test on synovial fluid, we started using this technique few months ago so we still do not have definitive results. The plastic surgeon's collaboration was required for wound closure with cutaneous flap for two patients.

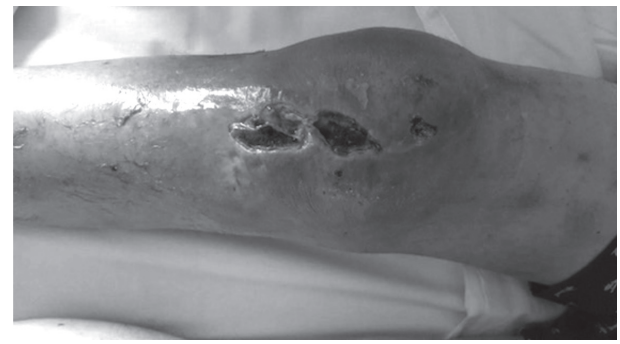

Figure 2.

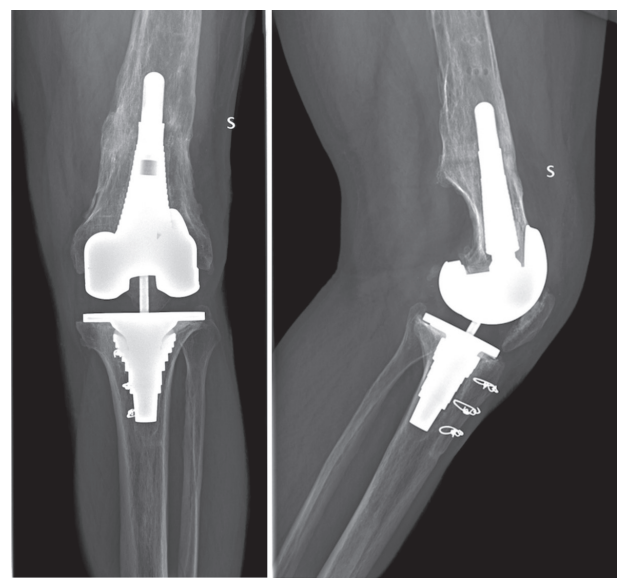

Figure 3.

Discussion

Limits of the study are a lack of control group with one-stage knee re-implantation and a middle term follow-up: we need long-term follow-up to confirm an optimal success rate of two-stage revision in periprosthetic total knee arthroplasty known in literature.

In 2012, Kubista et al. (22) published a work with 368 patients, with a success rate of 86% at 3,5 years of follow-up. In the same way, ten years before, Haleen et al. (23) had similar result: in a study of 94 patient, they had a success rate of 91% with 7,2 years of follow-up. In 2012, Romano et al. (24) published a meta-analysis about the difference between one and two stage revision in knee arthroplasty in 44 studies: success rate for one stage revision was 81,9% and for two-stage revision was 90%; in this work, in patient with almost 3 years of follow-up, success rate for two-stage revision remain the same, but one-stage revision success rate decrease at 79%. In 2013 Castelli et al. (25) showed a 92% success rate in 50 patients in a 7 years follow-up. One-stage revision in total knee artrhoplasty has variable results; it has shown to be successful mainly in healthy patient with highly susceptible organisms, with good soft tissues, minimal bone defects, without methicillin-resistant Staphylococcus aureus or methicillin-resistant Staphylococcus epidermidis (26, 27).

Which should be the best spacer to implant in the first surgery is a controversial topic. Most surgeons agree on use of antibiotic loaded cement spacers, but there is disagreement on the dose of antibiotics, and in static or articulating shape (24, 28-30).

Articulating spacers seems to have better results of eradication of infection than static spacer (24, 26). Static spacers, described the first time by Cohen in 1988 (31), is preformed in the shape of a hockey puck and it is inserted in the joint space; disadvantage are subluxation of the spacer, secondary bone loss and erosion of quadriceps mechanism. By the way, they have infection eradication rates approximating 88% (29, 32-35). In some case two-stage revision does not guarantee a good result. In 2014, Pelt et al. (36) analyzed 58 patients, with a failure rate of 36%. In 2016, Lindberg-Larsen (37) published a work of 205 two-stage revision and they had a failure rate of 30%; in 105 other they did a partial revision and in these cases they had a failure rate of 43%. In these cases, risk factors for failure were polymicrobial infection, execution of soft tissue coverage and multiple surgeries before primary TKA. They also analyzed recent study infected total knee arthroplasty and they found a mean failure rate of 17,3%, with range 0-34% (36). The advantage of this technique should be a better eradication of infection. The disadvantages include joint stiffness and pain in the interval between stages; at the second stage may be necessary quadriceps snip or tibial tubercle osteotomy as shown in our study. Tibial tubercle osteotomy is preferred to patella eversion to reduce failure of patella tendon and consequently of the extensor mechanism (35,38). So, this kind of surgery has to be considered as two major procedures with the associated morbidity, discomfort, cost and prolonged stay in hospital (39). For this reasons, it is a technique reserved in patient with late periprosthetic knee infection. Major contraindication is patient with important comorbidity.

Conclusion

In conclusion, chronic prosthetic infection remains a challenge for orthopedic surgeons, especially in knee arthroplasty. The management of this pathology has to be multidisciplinary, involving not only the orthopedic surgeon but also the infectivologist, the farmacologist and the microbiologist. In long-term follow-up studies, this technique has firm support in the literature. In the senior surgeon hands and in specialized centers it remains the gold standard for management of chronic infected TKA (26).

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