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Indications and Results of Condylar Constrained Implant in Primary Total Knee Replacement

Luigi Sabatini[1], Salvatore Risitano[2], Francesco Atzori[3], Alessandro Aprato[1] and Alessandro Massè[1]*

[1]*Department of Orthopaedics and Traumatology, Città della salute e della Scienza di Torino, CTO Hospital, Torino, Italy*

[2]*Department of Orthopaedics and Traumatology,University of Turin, Turin, Italy*

[3]*Department of Orthopaedics, Cottolengo Hospital, Torino, Italy*

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Introduction

Total knee arthroplasty (TKA) is nowadays a successful and valid procedure to restore proper function and give pain relief in patients with severe Knee osteoarthritis. This pathology has many clinical presentations and any patient arrives at physician's observation with different impairments of knee joint. Certainly to obtain a good result is necessary to restore a wide range of motion with a correct stability [1]. A proper balance of these two points is mandatory to achieve a knee prosthesis with a good function and a long term survival, in fact instability is a common indication for early revision after both primary and revision (TKA), accounting for up to 20% in the literature [2]. Therefore each clinical case requires a proper assessment that takes account of degrees, more or less advanced, of deformities and instability, associated with age-related criteria and patient related functional demands. Generally two different surgical techniques have driven the surgeon during research of the correct stability: Measured resection technique [3,4] and soft tissue gap balancing4, but independently from the surgical technique chosen the current authors consider that the use of major levels of constrained in primary TKA is sometime necessary to achieve better results.

Usually Constrained Condylar Knee (CCK) prosthesis are used for revision surgery, but can also help surgeons to improve implant stability in primary knee arthroplasty. For example in severe axial deformities where soft tissue balance is technical demanding or in osteoarthritis with medial and lateral compartment contracture and flexed knee that require an extensive release and can lead to residual instability [5,6]. Despite of the large use of CCK implants also in primary surgery, indications for use in primary total knee replacement are not so clear in literature.

The purpose of this paper is to discuss this topic after a review of the literature concerning the use of condylar constrained knee (CCK) implants in primary cases focusing our attention on the indications, complications and results.

Indication of condylar constraint implant in total knee arthroplasty

Indication on use of CCK in primary TKA is not well explained in literature. In most cases, knee surgeons perform primary TKA using posterior cruciate–substituting, above all posterior-stabilized(PS) or posterior cruciate–retaining (CR) implants; in this cases is simply to achieve proper alignment and soft tissue balancing is sufficient to obtain a good stability and satisfactory results; the criteria for this technique have been well established in recent literature [7].

When we approach more difficult knees, with sever axial deformity or collateral ligament failure, obtaining the goal of stability with a PS implant is more difficult. In this type of prosthesis the tibial eminence is not designed for stability but only to improve the femoral roll back and to replace the posterior cruciate ligament (PCL). In knees that are more seriously deformed and where significant instability is present, a more constrained articulation can be required [8] to achieve a stable knee.

In severe varus deformities and instability of the knee, in some cases, an important contracture on medial collateral ligament is recorded, associated with a flexion contracture of the pes anserine

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Correspondence:
Luigi Sabatini, Department of Orthopaedics and Traumatology, Città della salute e della Scienza di Torino, CTO Hospital, Torino, Italy, E-mail: luigisabatini.ort@gmail.com

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Figure 1: Severe valgus deformity of the left knee.

tendon and a consequent attitude at not reducible flexed knee. Furthermore tibial and femoral osteophytes are incorporated in soft tissue, their removal and the medial structures balancing requires an extensive release, that can lead to residual instability.

Also in severe valgus instability medial collateral laxity is often present and the surgeon have to try to correct that, but achieve satisfying soft tissue balance is technical demanding and in many cases an insufficiency of medial compartment is persistent. In these knees, the contact between tibial eminence and femoral condylar box is also useful to reduce an hyperextension attitude (Figure 1).

Nowadays different recent works yet recommend taking in account the use of a condylar constrained devices when it is particularly complex to gain adequate soft tissue balance. For example in chronic disease like rheumatoid arthritis, post-polio arthritis, Charcot like arthropathy, hemophiliac arthropathy and severe post-traumatic arthritis, that are characterized by instability and an important bone loss (Figure 2). In literature there are also some articles that suggest in case above reported, a more constrained implants than CCK. In fact rotating-hinge knee implants are also devices able to provide the stability needed for arthroplasty in case of severe bone loss and complex instability [9].

Eventually condylar constrained prosthesis are indicated also in case of intraoperative disruption or inadvertent sectioning of the medial collateral ligament with a resected or incompetent posterior cruciate ligament.

Most of the surgeons usually decide to use a semi constrained implant intraoperatively, when good ligament balance cannot be reached in both flexion and extension, only a few of them choose the type of the implant before surgery.

Complication and survival rate

First generations of semi constrained prosthesis (not modular) are associated with an high rate of patellar related pain and complication like fractures, incorrect tracking and osteonecrosis, but in 1998 with introduction of the second generation prosthesis with a new design more patellar friendly of femoral component, planed for right and left knees and now in use, the rate of patellar complication and the necessity of lateral retinacular release is real decreased [10].

Revision is more difficult especially in CCK with femoral and tibial stems, in fact stems are difficult to remove, especially if cemented, and this could cause an additional bone loss. Stems positioning extend surgical time and can eventually cause complications such as diaphiseal fractures [8], furthermore osteotomies may be necessary for stem removal, which adds morbidity and operating time.

Figure 2: Condylar constrained knee. Correct alignment of the left knee.

Use of stems is controversial: traditionally, CCK are used with stems to transfer load to the intramedullary canal and unload the bony interfaces but several papers show that is possible to use implant without femoral stem only if femoral bone is not deficient and well preserved for femoral implant support. If there is inadequate bone on the femoral side, a stem should be used routinely [8].

Recently some modular constrained knee system have been developed. This constrained condylar component has offered solutions to end of stem pain, canal invasion, complicated revision, and the high cost associated with diaphyseal stem extensions [11].

Previous studies reported CCK infection rate between 3 and 5% [12]. Jamsen with a register-based analysis of 43,169 cases shows several risk factors for infection after total knee arthroplasty and a correlation with type of prosthesis is clear. In this paper there was a trend showing an increased rate of infection in association with constrained and hinged prostheses in comparison with non-constrained devices, and the trend was statistically significant only for primary arthroplasties, not for revisions. However a low rate of infection is shown with a percentage of 1.17% instead of 0.7% demonstrated for cruciate retained/posteriorly stabilized prosthesis [13].

Previous studies with primary CCK knees also showed a low rate of aseptic loosening from 0% to 0.5% at short-term follow-up [14,15] and non-progressive radiolucent lines in other studies were reported in up to 16% of cases [16-18]. Maynard shows that radiolucent lines were found in 9.4% of cases. Most of them were in the medial tibial tray on the AP view (zones 1 and 2) and were < 1 mm. They were not progressive and likely suggest incomplete cement pressurization [19].

Little is known about the effect of condylar constraint on overall knee range of motion (ROM). Many studies report that an important theoretical disadvantage is the reduction of post-operative motion. Morgan et al has demonstrated that Internal and external rotation can be limited to within 2–3°, while coronal plane mobility can be limited to less than 2°[17]. With these changes in knee kinematics, one might suspect that overall ROM may be affected. But in a recent paper King BR compares postoperative ROM, pain, and function in patients receiving PS versus CCK inserts in the setting of a primary TKA, and founds at one year were within 1–2°, a difference which authors believe is not clinically significant. However they concluded that between the PS and CCK groups with regard to postoperative outcome variables over time, no differences were observed. The

Function and Knee Scores of the KSS, total arc of motion, passive extension, and passive flexion were all similar between groups. Additionally, they found no differences with incidence of flexion contracture ≥ 10° or incidence of maximum flexion ≥ 120°. When these models were adjusted for age and sex, there were no significant differences between PS and CCK for any of the postoperative outcome variables over time [18].

Literature shows a survival rate of this type of prosthesis that changes from 89% to 100 % with a mean follow-up from 5 to 10 years in the various studies.

Hartford analyzed with a retrospective study 33 patients of whom 17 are operated with CCK for primary replacement in case of multiplanar instability, severe bone loss, and rheumatoid arthritis. With a mean follow-up of 5 years, Range from 2 to 10 years, shows a survival rate of 91 % with a satisfying results: the evaluation with knee society protocol was excellent in 58% and good in 24% [14].

Lachiewicz et al. in 2006 considered 42 patients underwent to primary knee replacement with condylar constrained devices for valgus deformity with incompetent MCL in 27 cases, severe flexion contracture with inability to balance the knee in 12 and for other in 3. They obtained a survival rate at 10 years, range from 5 to 16 years, of 96% with excellent results in 12 and good in 24 of these [16].

Recently Maynard et al. evaluated 127 primary condylar constrained prostheses in patients with varus or valgus laxity greater than 5 mm at any point of knee range of motion. Their study has got a follow-up of 110.7 months with a survival rate of 89.9%. Complication rate was high and especially for patellar clunk syndrome, intra-operative and post-operative fractures and infection. No cases of aseptic loosening are reported [19].

Conclusion

Reviewing literature, for second-generation semi-constrained knee prosthesis, represent safe and practical treatment in primary TKA in case of severe deformity that need extensive soft tissue release and when it is very difficult to obtain stable knees both in extension and in flexion.

In our opinion second-generation semi-constrained knee prosthesis can be take as a first chiese option in primary TKA in elderly patients in case of varus or valgus deformity to avoid the risk of residual instability; their use is safe and effective and this kind of patients expected low functional demand activity.

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