

# Condylar constrained system in primary total knee replacement: our experience and literature review

Luigi Sabatini<sup>1</sup>, Salvatore Risitano<sup>1</sup>, Lorenzo Rissolio<sup>1</sup>, Andrea Bonani<sup>1</sup>, Francesco Atzori<sup>2</sup>, Alessandro Massè<sup>1</sup>

<sup>1</sup>Orthopedics and Traumatology Department, University of Study of Turin, Turin, Italy; <sup>2</sup>Department of Orthopedic, Cottolengo Hospital, Turin, Italy

**Contributions:** (I) Conception and design: All authors; (II) Administrative support: All authors; (III) Study materials and patients: All authors; (IV) Collection and assembly of data: All authors; (V) Data analysis and interpretation: All authors; (VI) Manuscript writing: All authors; (VII) Final approval of manuscript: All authors.

**Correspondence to:** Salvatore Risitano. Orthopedics and Traumatology Department, University of Study of Turin, Turin, Italy. Email: srisitano@gmail.com.

**Background:** Constrained condylar knee (CCK) prosthesis are common used for revision surgery but can also help surgeons to improve implant stability in primary knee arthroplasty, in fact in severe knee arthrosis with serious deformity associated with a significant instability a more constrained articulation is required. With introduction of second generation of semi-constrained prosthesis, rate of complication is real decreased and a good survival rate and functional score results is showed. In this paper we write about our experience using CCK in primary knee arthroplasty.

**Methods:** Between January 2012 and December 2015, 28 second-generation semi-constrained knee arthroplasties were performed as a first implant. Two different types of implants were used: 10 constrained condylar knee (CCK Zimmer) and 18 TC3 (DePuy Johnson & Johnson). All patients were over 75 years old (mean 81.75) with a severe deformity and clinical evaluations at 2-, 6-, 12-month after surgery and every year performed. X-rays at 6, 12 months and then annually was planned with an average follow-up of 31.28 (range 6–48) months.

**Results:** No patients were lost during the follow-up. The mean functional knee society score (KSS) improved from 30 points preoperatively to 92.1 points at the last follow-up. All patients recovered full extension during follow-up and no radiolucent lines were showed at X-ray control. There were no deep infections or peri-prosthetic fractures.

**Conclusions:** Second generation semi-constrained knee prosthesis represent safe and practical treatment in primary total knee arthroplasty (TKA) in case of severe deformity that can't be managed with accurate soft tissue release, especially in elderly patients.

**Keywords:** Condylar constrained knee; primary knee arthroplasty; total knee replacement

Submitted Jan 24, 2017. Accepted for publication Feb 15, 2017.

doi: 10.21037/atm.2017.03.29

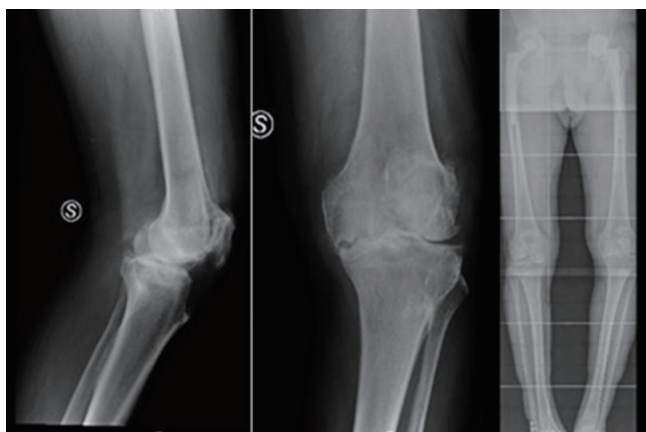
**View this article at:** <http://dx.doi.org/10.21037/atm.2017.03.29>

## Introduction

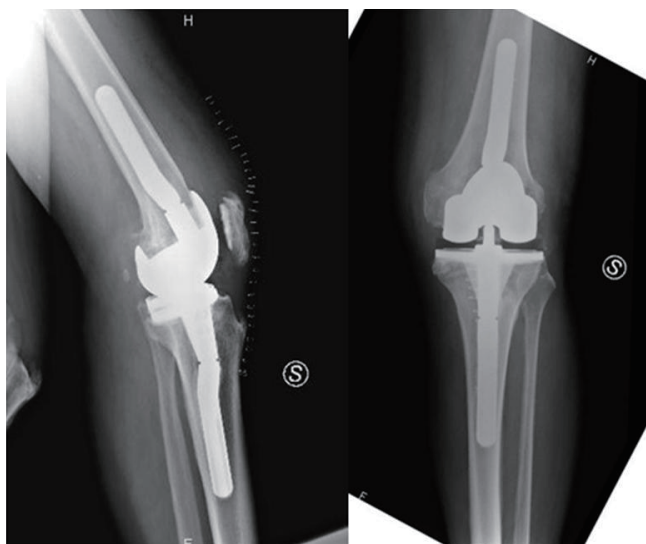
Knee stability after total knee replacement is the cornerstone to achieve good long-term implants survival (1). Severe axial deformities represent a challenge in total knee arthroplasty (TKA) because achieve satisfying soft tissue balance is technical demanding. Moreover, medial and lateral compartment contracture and flexed knee often require an extensive release, that can lead to residual instability.

Constrained condylar knee (CCK) can help surgeons to improve implant stability, where soft tissue balance is not satisfying; this is true not only during revision but also for primary TKA (2). Traditionally, most common use for CCK is revision surgery; other indication are soft-tissue related instability, broad bone defects and axial deformity (3,4).

Early studies showing poor results limited in the past the use of CCK for first implants but recent several



**Figure 1** Pre-operative X-ray: anteroposterior (AP) and lateral views and tele-radiography.



**Figure 2** Post-operative X-ray.

works demonstrate better long-term survival outcomes. This allows more confident CCK chose also in primary replacements, when marked instability is present (5).

Second generation CCK prosthesis had moreover reduced some complications to the patella (e.g., fractures, incorrect tracking and osteonecrosis) thank to redesigned patellofemoral surfaces (6).

The aim of our work was to evaluate, with a critical review of literature, clinical results and complications of our experience with Condylar Constrained prosthesis, used in primary knee arthroplasty, where preoperative axial deformity or flexion contracture were present.

## Methods

Between January 2012 and December 2015, 28 second-generation semi-constrained knee arthroplasties were performed as a first implant. Two different types of implants were used: 10 constrained condylar knee (CCK Zimmer) and 18 TC3 (DePuy Johnson & Johnson).

All patients were over 75 years old (mean 81.75; range, 75–89 years old), with a severe deformity: preoperative planning was made and a semi constrained TKA was performed in knees with a valgus over  $15^\circ$  or varus over  $10^\circ$  with or without collateral ligament failure. 10 of 28 knees had a valgus deformity and 18 had a varus deformity (Figure 1).

All varus knees were performed with a medial skin incision and a medial para-patellar approach, meanwhile 5 of 10 valgus knees needed a lateral para-patellar Keblish's approach. Intramedullary femoral and tibial guide was used routinely. Stem extensions were always used and all components were cemented. In four cases of advanced osteoporotic disease (all managed with TC3 arthroplasty) metal sleeves were used.

In 26 cases cemented patella resurfacing was performed: 1 case there was a high grade of osteopenia, and in another one patella was not thick enough to perform it.

We reviewed retrospectively clinical and radiographic outcomes of primary total knee replacement with an average follow-up of 31.28 (range 6–48 months) months.

All patients were evaluated clinically at 2-, 6-, 12-month after surgery and every year after surgery. X-rays was planned at 6, 12 months and then annually. We use knee society score (KSS) functional score for clinical evaluation (7).

## Results

We reviewed 28 knees with a semi constrained arthroplasty as first implant. No Patients were lost during the follow-up.

The mean KSS improved from 30 points preoperatively to 92.1 points at the last follow-up. The mean KSS objective scoring improved from 20 points preoperatively to 87.25 points at the last follow-up.

Mean postoperative flexion was  $98.9^\circ$  ( $90^\circ$  to  $120^\circ$  was reached in all cases); all patients recovered full extension during follow-up.

X-rays showed no radiolucent lines in all knees neither in femur nor in tibia. No component loosening or periprosthetic fracture was reported. At the same, there were no deep infections of the operated joints (Figure 2).

Three patients suffered of thigh pain in the immediate

post operatory, solved after 3–4 months of magnetic field treatment. No revisions or reoperations were performed.

## Discussion

It is rare to need a semi-constrained implant in primary TKA due to ligament instability or significant bone defects; different recent works yet recommend to take in account the use of a CCK when it is particularly complex to gain adequate soft tissue balance.

Insall *et al.* (4) and Donaldson *et al.* (3) had already described indications to CCK replacement among which are included severe axial deformities, collateral ligaments insufficiency and severe bone loss. Chronic disease like severe rheumatoid arthritis, post-polio arthritis, Charcot-like arthropathy, hemophilic arthropathy and post-traumatic arthritis are more frequently involved.

This type of prosthesis can also be helpful to gain correct stability in case of disruption or inadvertent sectioning of collateral ligaments in the operatory room and anyway most of the authors usually decide to use a semi constrained implant intraoperatively, when good ligament balance cannot be reached in both flexion and extension.

Negatives about the use of semi constrained knee prosthesis include larger bone removal due to the components design and risk of worst results in terms of pain (8). Furthermore many studies report that an important theoretical disadvantage is the reduction of post-operative motion. It showed that Internal and external rotation can be limited to within 2°–3°, while coronal plane mobility can be limited to less than 2° (9). 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 finds at 1 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 the total arc of motion, passive extension, and passive flexion were all similar between groups. Additionally, they found no differences with incidence of flexion contracture  $\geq 10^\circ$  or incidence of maximum flexion  $\geq 120^\circ$ , When these models were adjusted for age and sex (10).

We tried to give a pre-operative indication for elderly patients (over 75 years old) that present knees with a severe valgus ( $>15^\circ$ ) or varus ( $>10^\circ$ ) deformities to avoid difficult soft tissue release with high risk of residual instability in subjects with low functional requests.

Studies about the first generation of semi constrained

prosthesis (not modular) already demonstrated a good survivorship (96% at 10 years of follow-up) but with a high rate of patellar pain and complication (fractures, incorrect tracking and osteonecrosis) (5). With introduction of the second generation prosthesis, now in use, the rate of patellar complications and the need of lateral retinacular release decreased sensibly (6).

Our experience shows good clinical outcome and patient satisfaction after primary knee replacement with CCK prosthesis.

We always intraoperatively evaluated articular surface degeneration of the patella and every time we could, we performed patella resurfacing. We did not point out important complications related to patellofemoral joint and to extensor mechanism in general. No fractures or necrosis of the patella was reported.

Several works described aseptic loosening of the components due to polyethylene wear, but other studies with mid-term and long term follow-up showed good results: Lachiewicz (27 knees) (6) and Cholewinski *et al.* (43 knees) (8) had no mechanical loosening respectively after mean follow-up of 5.4 and 12.3 years. 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 According to literature we did not find any loosening in our series (11).

Previous studies reported CCK infection rate between 3% and 5% (12), but in literature often is unclear if infection rate in primary CCK TKA differs from that reported for PS implants. Jansen with a register-based analysis of 43, 169 cases shows several risk factors for infection after TKA 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).

Use of femoral and tibial stems is controversial and recently on 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 (14).

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 when 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. Obviously in case of revision, stems are difficult to remove, especially if cemented, and this could cause an additional bone loss. Stems positioning lengthens surgical time and can eventually cause diaphyseal fractures (15). Anderson *et al.* (16) reported good results of 55 knees using a constrained condylar prosthesis without stem extensions: at 44.5 months of follow-up they had only one case of femoral loosening and one case of tibial fracture.

We always decided to apply femoral and tibial stems as suggested by surgical techniques of the chosen implants. We used also metal sleeves in four cases with an important osteoporotic disease (always with TC3 DePuy prosthesis). We did not experience any diaphyseal fracture during our series. In three cases patients suffered of thigh pain in the immediate post operatory, probably related with femoral stem. Pain resolved with magnetic field treatment after 3–4 months, without sequelae.

Mean KSS improvement after surgery was similar to other previous studies (17).

Mean postoperative ROM was 98.9°. All knees had reach complete extension at last follow-up.

At last follow-up we found no difference in KSS and ROM between Depuy-TC3 group and LCCK-Zimmer group. From our data we think that surgeon practice should remain the only proper selection criterion.

We are aware our work present several important limitations. First of all, it is a retrospective study that comprehend a small number of cases. Our cohort is representative for elderly patients with severe axial knee deformities. Results in term of satisfaction after surgery and local pain and/or discomfort could have been different for younger patients (18).

However we are confident to say that CCKs can be good and reliable prosthesis for elderly patients with axial deformity of the knee. Surgical technique is less demanding and results seem to be similar compared to primary implant after extensive ligaments release.

## Conclusions

Second generation semi-constrained knee prosthesis represent safe and practical treatment in primary TKA in case of severe deformity that can't be managed with accurate soft tissue release, especially in elderly patients. Despite CCK

are less performant implants, their use is also reasonable in difficult knees when low functional demand is expected. In future more other studies must confirm our findings.

## Acknowledgments

None.

## Footnote

*Conflicts of Interest:* The authors have no conflicts of interest to declare.

## References

1. Fehring TK, Odum S, Griffin WL, et al. Early failures in total knee arthroplasty. *Clin Orthop Relat Res* 2001;(392):315-8.
2. Hartford JM, Goodman SB, Schurman DJ, et al. Complex primary and revision total knee arthroplasty using the condylar constrained prosthesis: an average 5-year follow-up. *J Arthroplasty* 1998;13:380-7.
3. Donaldson WF 3rd, Sculco TP, Insall JN, et al. Total condylar III knee prosthesis. Long-term follow-up study. *Clin Orthop Relat Res* 1988;(226):21-8.
4. Insall JN, Ranawat CS, Aglietti P, et al. A comparison of four models of total knee-replacement prostheses. *J Bone Joint Surg Am* 1976;58:754-65.
5. Lachiewicz PF, Soileau ES. Ten-year survival and clinical results of constrained components in primary total knee arthroplasty. *J Arthroplasty* 2006;21:803-8.
6. Lachiewicz PF, Soileau ES. Results of a Second-Generation Constrained Condylar Prosthesis in Primary Total Knee Arthroplasty. *J Arthroplasty* 2011;26:1228-31.
7. Insall JN, Dorr LD, Scott RD, et al. Rationale of the Knee Society clinical rating system. *Clin Orthop Relat Res* 1989;(248):13-4.
8. Cholewinski P, Putman S, Vasseur L, et al. Long-term outcomes of primary constrained condylar knee arthroplasty. *Orthop Traumatol Surg Res* 2015;101:449-54.
9. Morgan H, Battista V, Leopold SS. Constraint in primary total knee arthroplasty. *J Am Acad Orthop Surg* 2005;13:515-24.
10. King BR, Gladnick BP, Lee YY, et al. Range of motion and function are not affected by increased post constraint in patients undergoing posterior stabilized total knee arthroplasty. *Knee* 2014;21:194-8.
11. Maynard LM, Sauber TJ, Kostopoulos VK, et al. Survival

- of primary condylar-constrained total knee arthroplasty at a minimum of 7 years. *J Arthroplasty* 2014;29:1197-201.
12. Cury Rde P, Cinagawa EH, Camargo OP, et al. Treatment of infection after total knee arthroplasty. *Acta Ortop Bras* 2015;23:239-43.
  13. Jämsen E, Huhtala H, Puolakka T, et al. Risk factors for infection after knee arthroplasty. A register-based analysis of 43,149 cases. *J Bone Joint Surg Am* 2009;91:38-47.
  14. Ruel A, Ortiz P, Westrich G. Five year survivorship of primary non-modular stemless constrained knee arthroplasty. *Knee* 2016;23:716-8.
  15. Sculco TP. The role of constraint in total knee arthroplasty. *J Arthroplasty* 2006;21:54-6.
  16. Anderson JA, Baldini A, MacDonald JH, et al. Constrained condylar knee without stem extensions for difficult primary total knee arthroplasty. *J Knee Surg* 2007;20:195-8.
  17. Ye CY, Xue DT, Jiang S, et al. Results of a Second-generation Constrained Condylar Prosthesis in Complex Primary and Revision Total Knee Arthroplasty: A Mean 5.5-Year Follow-up. *Chin Med J (Engl)* 2016;129:1334-9.
  18. Feng XB, Yang C, Fu DH, et al. Mid-term outcomes of primary constrained condylar knee arthroplasty for severe knee deformity. *J Huazhong Univ Sci Technolog Med Sci* 2016;36:231-6.

**Cite this article as:** Sabatini L, Risitano S, Rissolio L, Bonani A, Atzori F, Massè A. Condylar constrained system in primary total knee replacement: our experience and literature review. *Ann Transl Med* 2017;5(6):135. doi: 10.21037/atm.2017.03.29