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Original article

Total knee implant posterior stabilised by a third condyle: Design evolution and post-operative complications

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ABSTRACT

Background: Despite excellent long-term outcomes, posterior stabilisation by a third condyle continues to receive unwarranted criticism regarding patellar complications and instability.
Hypothesis: Complication rates with a tri-condylar posterior-stabilised implant are similar to those with other posterior-stabilised prostheses and have diminished over time due to improvements in prosthesis design.
Material and methods: Post-operative complications and revision rates were assessed retrospectively in a prospective cohort of 4189 consecutive patients who had primary total knee arthroplasty (TKA) using a tri-condylar posterior-stabilised implant (Wright-Tornier) and were then followed-up for at least 24 months. The analysis included 2844 knees. The prosthesis generations were HLS1®, $n = 20$; HLS2®, $n = 220$; HLS Evolution®, $n = 636$; HLS Noetos®, $n = 1373$; and HLS KneeTec®, $n = 595$. Complications were compared across generations by applying Fisher's exact test, and survival was compared using the Kaplan-Meier method.
Results: At last follow-up, there had been 341 (12%) post-operative complications in 306 (10.8%) knees, including 168 (5.9%) related to the implant, 41 (1.4%) infections, and 132 (4.6%) secondary complications unrelated to the implant. Re-operation was required for 200 complications (7%), including 87 (3.1%) consisting in revision of the prosthesis. Implant-related complications were stiffness ($n = 67$, 2.4%), patellar fracture ($n = 34$, 1.2%), patellar clunk syndrome ($n = 25$, 0.9%), patellar loosening ($n = 3$, 0.1%), tibial/femoral loosening ($n = 15$, 0.5%), polyethylene wear ($n = 3$, 0.1%), and implant rupture ($n = 1$, 0.04%). Significant differences across generations were found for stiffness ($P < 0.0001$), patellar fracture ($P = 0.03$), clunk syndrome ($P = 0.03$), and polyethylene wear ($P = 0.004$), whose frequencies declined from one generation to the next. Overall 10-year survival was 92% with no significant difference across generations ($P = 0.1$).
Discussion: Outcomes of tri-condylar posterior-stabilised TKA are similar to those obtained using other posterior-stabilised implants. Neither patellar complications nor instability are more common, and improvements in implant design have contributed to correct early flaws.
Level of evidence: IV, historical cohort, retrospective assessment of prospectively collected data.

1. Introduction

Posterior stabilisation improves total knee arthroplasty (TKA) stability during flexion, while also facilitating the implantation procedure [1–3]. The technical methods used to achieve posterior stabilisation include the post-cam design, third condyle design, and use of ultracongruent polyethylene [3].

Despite substantial advances, failures continue to occur and prosthesis exchange is required in some cases. The causes of failure are infection, complications related to the implant and its design [4,5], and secondary complications unrelated to the implant (component malposition, technical error, fracture, extensor mechanism rupture, haematoma, and pain) [6].

Since 1987, we have been using a TKA implant posterior stabilised by a third condyle, which has provided excellent clinical and radiological outcomes [7–9]. This type of implant has been accused of generating patello-femoral complications (third condyle), providing less stability during knee flexion (absence of a cam mechanism), and promoting tibial component loosening (increased weight-bearing loads). These criticisms were voiced early after the introduction of tri-condylar posterior-stabilised TKA, whose design has been improved substantially since then.

No studies have assessed complications after tri-condylar posterior-stabilised TKA in a large sample size. Furthermore,

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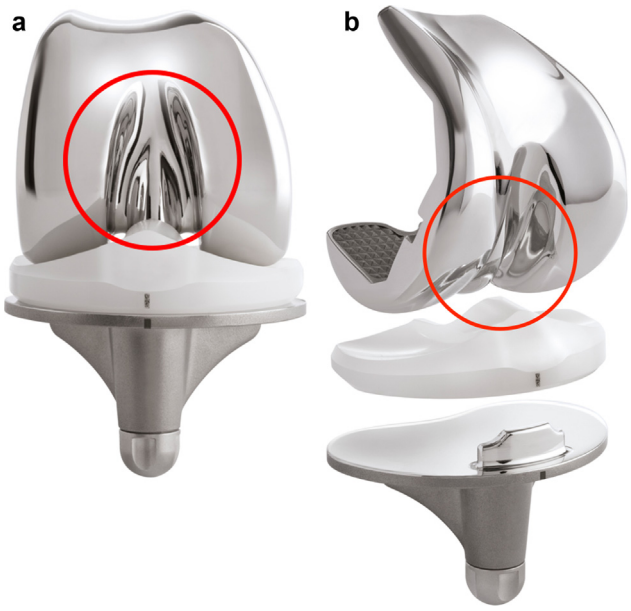

Fig. 1. HLS KneeTec® with its third condyle (front and side views).

potential changes in complication rates with each improvement in implant design have not been investigated. The objective of this study was to record all local post-operative complications in a cohort of 4189 primary tri-condylar posterior-stabilised TKAs performed over nearly 30 years and to assess survival of each implant generation. The working hypothesis was that tri-condylar posterior-stabilised TKA had similar complication rates to those seen with other posterior-stabilised implants and that the incidence of complications declined from one tri-condylar posterior-stabilised implant generation to the next.

2. Material and methods

2.1. Implants

Since 1987, all implants used at our centre have been from the same manufacturer (Wright-Tornier, Montbonnot Saint Martin, France). With these implants, the posterior cruciate ligament is removed and posterior stabilisation is achieved by a convex third condyle in the mid-posterior position that contacts a matching projection on the tibial polyethylene insert beyond 30° to 60° of flexion, depending on implant generation (Figs. 1 and 2). Five generations of the implant were used:

- HLS1® (1987–1990) with a fixed tibial tray, asymmetrical posterior femoral condyles to promote external rotation, a non-anatomical trochlea, and a spherical patellar button with a single central peg;
- HLS2® (1990–1996) with asymmetrical femoral condyles and a more anatomical trochlear design including a groove in 7° of valgus;
- HLS Evolution® (1995–2004) with a fixed or rotating tibial tray, a trochlear design modification in the inter-condylar region, and a patellar button with three pegs;
- HLS Noetos® (starting in 2000) with a deeper trochlear groove, so that patellar resurfacing is no longer mandatory;
- HLS KneeTec® (starting in 2009) with a rotating tray and conical tibial keel with delta fins, availability of standard and narrow widths (the latter for average-sized femurs to diminish medio-lateral size), and a modified trochlear design that extends the patellar course during knee flexion.

2.2. Patients

This single-centre retrospective study was based on a prospective cohort of 4189 consecutive primary TKAs performed at a single surgical department between November 1987 and March 2015 by several surgeons, all of whom used the same surgical technique. The patients underwent clinical and radiological evaluations after 1 year and 2 years then every 2 years. Table 1 reports the main patient characteristics before surgery.

The French advisory committee on health research data processing (*Comité Consultatif sur le Traitement de l'Information en matière de Recherche dans le domaine de la Santé* [CCTIRS]) approved this study on 24 January 2012 then 9 March 2015 (approval #11-681).

2.3. Operative technique

Before 1996, a medial approach was used consistently. Subsequently, the approach varied with the initial knee deformity: medial for varus knees and lateral for valgus knees, with anterior tibial tubercle elevation if needed.

Posterior referencing was used, with the tibial cut performed first and the femoral cut second (balancing in flexion then replication of the gap in extension, adjusted using a distractor before the femoral distal cut). Only 18 (0.4%) patellas were not

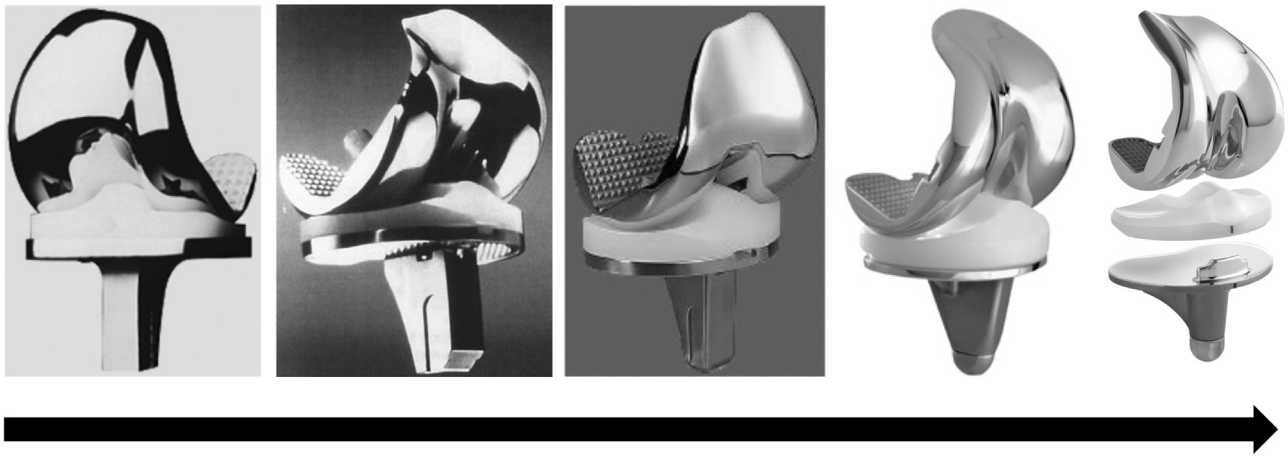

Fig. 2. Successive generations of the HLS implant (from left to right: HLS1®, HLS2®, HLS Evolution®, HLS Noetos®, and HLS KneeTec®).

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