Functional outcomes comparing Triathlon versus Duracon total knee arthroplasty: does the Triathlon outperform its predecessor?

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Abstract

Purpose Total knee arthroplasty (TKA) prosthesis designs are constantly evolving to obtain greater functional performance. The aim of this study is to compare the functional outcomes between the newer single radius (SR) Triathlon prosthesis with its multiradius (MR) predecessor the Duracon.

Method We analysed 1,012 primary TKA procedures which used either the Triathlon SR prosthesis or the Duracon MR prosthesis (338 Triathlon, 674 Duracon). Patients were assessed using the Knee Society score (KSS), range of movement measurements, pain and walking assessments at time points pre-operatively, one year and two years postoperatively. **Results** Both groups were similar pre-operatively in terms of age, gender and body mass index (BMI). At one year postoperatively the Triathlon group had a significantly better flexion ($P=0.005$) and KSS (function score $P=0.037$, knee score $P=0.000$). At two years postoperatively the Triathlons had maintained a significantly better KSS (function score $P=0.046$, knee score $P=0.000$) and also knee flexion ($P=0.02$). Pain assessments at two years were significantly better in the Triathlon group ($P=0.002$) with 66.3 % of patients experiencing no pain at that point compared to 54.4 % with Duracon knees.

Conclusion This data supports the proposition that the use of Triathlon TKA results in improved outcomes for patients when compared to the Duracon TKA.

Keywords Triathlon · Duracon · Arthroplasty · Functional outcomes

Introduction

Total knee arthroplasty (TKA) is an effective and successful operation for the treatment of osteoarthritis of the knee by reducing pain and restoring function. The design of prostheses is constantly evolving as surgeons and orthopaedic implant manufacturers endeavour to meet the higher expectations that patients now have regarding functional performance following TKA. Patients undergoing TKA are younger, heavier and more active [1] and their increased demands correlate to their active lifestyles, particularly in regards to deep knee flexion [2]. The performance of the Duracon knee system has been well documented and studied [3–7], and it has been shown to have good long-term survival rates [4–7]. It is normal practice for implant companies to introduce new models of TKA without clinical data to confirm that there are clinical benefits to design improvements compared to previous designs.

The Triathlon knee prosthesis (Stryker Orthopaedics, Mahwah, New Jersey) has evolved from modifications to its predecessor the Duracon (Stryker). The most notable difference is the anatomic radius. The Triathlon has a single radius (SR) in contrast to the Duracon multiradius (MR) implant. Churchill et al. [8] showed that the transepicondylar axis used in the Triathlon knee closely approximates the optimal flexion axis. This was thought to maintain collateral ligament stability throughout range of motion. Another notable difference is the seven degree anterior flange of the Triathlon. Through the use of anthropometric measurements by Hitt et al. [9] the flange was thought to allow for improved flexibility to downsize the femoral component without notching the femur and to provide a more customized fit. Furthermore, the Triathlon has flared posterior condyles to accommodate 20 degrees of internal and external rotation throughout range of motion. Through these changes it was thought the Triathlon would mimic natural knee kinematics, aiming to deliver greater patient satisfaction [10].

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The aim of this study was to compare the functional outcomes between the new SR Triathlon prosthesis with its MR predecessor Duracon at several time points, preoperatively and postoperatively after one and two years. We hypothesized that patients who received the newer Triathlon SR total knee prosthesis would have improved functional outcomes.

Methods

Total knee arthroplasties performed at our institution are all prospectively monitored. Patients are examined by physiotherapists pre-operatively and at one and two years postoperatively. A review of the database at our institution identified 1,012 primary TKA procedures that had at least two years of postoperative data, which used either a Triathlon TKA prosthesis ($n=338$) or a Duracon TKA prosthesis ($n=674$). All surgeries were performed at a single institution. Inclusion criteria for this study consisted of surgical treatment for osteoarthritis or rheumatoid arthritis and the use of either the Triathlon or Duracon implant. We have excluded posterior stabilized implants because there would be a few of these in each group and that represents a different implant. Patella resurfacing was performed selectively based on condylar condition. Patients must have had at least two years of postoperative follow-up data to be included in the study population. At each visit patients were assessed using the KSS [11] and had their range of movement measured.

Statistical analysis

Chi-square analysis was used to compare gender, pain and walking results between the two groups. T tests were performed to compare differences in age and BMI pre-operatively and to compare the KSS and knee flexion at each time frame between the groups. A p -value <0.05 was considered statistically significant.

Results

Of the 1,012 knee arthroplasties reviewed there were 338 patients in the Triathlon group compared to 674 patients in the Duracon group. Age, gender and BMI were not significantly different between the two groups (Table 1). Pre-operative KSS were significantly worse in the Duracon group in both the knee component and the function component of the score (Table 1). These results are reflected in less walking distance ($P=0.000$) and a higher percentage of severe pain ($P=0.017$) in the Duracon group compared to the Triathlon group. Pre-operative flexion between the two groups was not significantly different (Table 1).

At one year postoperatively the Triathlon group had a significantly better knee flexion and Knee Society scores

Table 1 Demographics and preoperative mean scores (standard deviations)

Demographic	Triathlon	Duracon	P-value
Participants	338	674	
Mean age (SD)	69.4 (9.3)	70.2 (9.2)	0.236
Gender female	215 (63.6 %)	419 (62.2 %)	0.353
Mean BMI (SD)	31.8 (6.2)	31.2 (6.2)	0.156
KSS – Knee	41.8 (14.9)	37.5 (17.9)	0.000
KSS – Function	49.7 (17.3)	44.2 (18.4)	0.000
Knee flexion	105.4 (16.3)	107.3 (18.1)	0.09

SD standard deviation, BMI body mass index, KSS Knee Society score

(Table 2). The improvement between pre-operative and one year trended towards significance for the knee component of the KSS with the Triathlon showing more improvement at one year from pre-operative than the Duracon.

At two years postoperatively the Triathlon had significantly better knee flexion, knee score and function score (Table 2). Although significant, the difference in outcomes between the two groups was small.

The improved knee score, function score, and knee flexion seen in the Triathlon group at two years did not correlate to significant advantages in postoperative walking distance between the two groups ($P=0.791$). However, both groups showed the expected significant improvement compared to pre-operative values. Pain assessments at two years were significantly better in the Triathlon group ($P=0.002$; Fig. 1), particularly with a higher percentage of patients having no pain.

Discussion

Implant manufacturers have attempted to introduce new prostheses to meet the higher expectations in terms of functional

Table 2 One- and two-year postoperative mean scores (standard deviation)

Scores	Triathlon	Duracon	P-value
KSS - Knee			
1 year	88.4 (10.3)	82.9 (13.5)	0.000
2 years	89.5 (11.1)	83.5 (14.8)	0.000
KSS – Function			
1 year	72.5 (19.4)	69.7 (21.2)	0.037
2 years	71.7 (21.5)	68.7 (23.0)	0.046
Knee flexion			
1 year	107.2 (12.4)	104.8 (13.3)	0.005
2 years	108.5 (12.5)	106.5 (13.7)	0.02

KSS Knee Society score

Fig. 1 Two year postoperative pain level

outcomes and patient satisfaction [12]. With the Duracon TKA system now removed from the market, the use of the Triathlon TKA has become favoured by many surgeons [13]. There are no available randomized controlled trials, nor long-term cohort studies comparing the two implants. The purpose of this study was to evaluate whether the functional outcomes of the Triathlon TKA exceeds the performance of its predecessor, the Duracon TKA assessed using functional outcome-based scores.

The Duracon knee prosthesis is a femoral MR TKA prosthesis. It was used for over 20 years until being superseded by the Triathlon knee prosthesis, a femoral SR TKA. The MR knee was previously thought to be the gold standard prosthetic design as it correlated with the multiple simultaneous pivot points of knee flexion and extension that exist in a normal knee joint [14]. The SR design has a fixed axis of rotation centered about the transepicondylar axis, which maintains ligament tension and substantial contact throughout the range of motion [3]. This is thought to allow for uniform movement, lower contact stress on the inlay, better mid flexion stability, and enables a mechanical advantage of the quadriceps muscles during extension of the knee [3, 15, 16]. The Triathlon also has flared femoral posterior condyles thought to aid rotation during deep knee flexion [2].

We believe surgeons adopted the newly introduced Triathlon SR prosthesis for two reasons. The early adopters had belief in the newer engineering changes coupled with better instrumentation, whereas the later adopters converted once the Duracon was withdrawn from the market or during early publication of the performance of the new design.

Comparative trials were not available to help surgeons with this decision.

The Australian Joint Replacement Registry reports a cumulative revision rate of 3.4 % at five years for the Duracon TKA system and 2.8 % five year revision rate for the Triathlon prosthesis [4]. The revision rates reported in national joint registries do not take into account how the prosthesis is performing functionally.

Molt et al. [2] show the Triathlon prosthesis performing at least as well as the Duracon in terms of early stability. They looked at early migration characteristics and functional outcomes of the same two knee arthroplasty systems using radiostereometric analysis (RSA). However, their study was limited with the small sample size in each group. Looking at their clinical outcomes using the KSS we found they were similar to the results obtained from our data at the one- and two-year postoperative time frames. Cook et al. [3] have also looked at functional outcomes comparing the Triathlon and the Duracon TKA. Their data also supported the use of SR implants. Their study was limited by the statistically different age demographics of the two groups and also surgical approach, which were potentially confounding variables. The outcome results reported in this study for Duracon implants is similar to previous reported series [5–7].

The difference in postoperative pain is the most clinically significant difference demonstrated by this study with 66.3 % of Triathlon patients experiencing no pain two years postoperatively compared to only 54.4 % in the Duracon group. This result could be partly explained by the higher levels of pain experienced preoperatively by the Duracon group.

Whilst there are statistically significant differences in the KSS between the two prostheses, the clinical significance of these given the small magnitude in difference is debatable. The knee component of the KSS differs by six points and the functional component differs by only three points between the two groups at two years post operation. This is highlighted by the lack of differentiation between the groups for walking distance, use of walking aids and stair climbing ability.

Our study was limited by the fact that it was a non-randomized cohort. This means that the bias would be expected to favour the Triathlon implant because these surgeries were performed later, enabling improved instrumentation and potentially better postoperative rehabilitation and analgesia. The differences seen in the two groups pre-operatively, with lower KSS and higher pain levels in the Duracon group, were presumed to be due to the longer waiting list times at our institution in the earlier years covered by this study. The strengths of our study were that it was data from a single institution with a large cohort and that these patients were subject to independent follow up by trained physiotherapists.

Conclusions

The data from 1,012 primary TKA performed at our institution has shown that the SR Triathlon performs significantly better than its MR predecessor Duracon in terms of KSS and knee flexion at two years postoperatively, but the differences are small. The most clinically significant difference was the 21.9 % improvement in the number of patients in the Triathlon group not experiencing any pain two years post knee arthroplasty.

Despite the engineering and design advances in the Triathlon knee arthroplasty there remained over 6 % of patients with at least moderate occasional pain. The relatively small functional improvements seen with evolution in design suggest the ongoing need to strive for improvement in TKA implants and techniques.

Conflict of interest Author G.C. has a consultancy with Stryker. There has been no sponsorship received for this research.

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