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Research Article

COMPARATIVE ANALYSIS OF SURVIVORSHIP, CLINICAL OUTCOMES, AND RADIOLOGICAL ALIGNMENT IN PRIMARY UNICOMPARTMENTAL KNEE ARTHROPLASTY: ALLEGRETTO VS. EIUS IMPLANTS WITH NAVIGATION

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ABSTRACT
In this study focusing on patients diagnosed with medial compartmental osteoarthritis, we conducted an examination of 60 consecutive cases of primary unicompartmental knee arthroplasty (UKA) performed by a single surgeon. Among these cases, 30 were treated with Allegretto knee implants without navigation, and the remaining 30 received EIUS knee implants with the aid of navigation. The evaluation encompassed survivorship, radiological measurements, and clinical outcomes, with comparisons conducted at average follow-up periods of 8.8 and 6.8 years, respectively. Radiological alignment assessments were carried out using both long-leg weightbearing X-ray images and non-weight bearing computed tomography scans. In addition to radiological evaluations, clinical outcomes were assessed using the Oxford Knee Score (OKS). At the 9-year mark, a notable 88.9% of patients maintained survival. Interestingly, a trend emerged where malaligned knees exhibited lower OKS values compared to well-aligned knees, with alignment consistency playing a role in this observation. In contrast, despite these nuances, no statistically significant disparities were identified between the two groups in terms of survival rates, clinical outcomes, or radiological alignment.

Key words:-. Osteoarthritis, Knee implants, Computed Tomography, Radiological Alignment.

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INTRODUCTION

Unicompartmental knee arthroplasty (UKA) has demonstrated its effectiveness as a viable long-term treatment option for individuals with isolated medial compartmental osteoarthritis (OA), as substantiated by previous research [1-3].

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Approximately 21% of males and 12% of females are affected by isolated medial compartmental OA [4], encompassing around 85% of knees with clinical OA [5]. In comparison to total knee arthroplasty (TKA), UKA presents a less invasive and more advantageous approach that reproduces kinematics more accurately, leading to quicker recovery, enhanced range of motion, and improved physiological function [6, 7]. It's noteworthy, however, that despite these merits, the utilization of unicompartmental knee replacement has witnessed a decline according to national joint registries in recent times [8, 9]. Nonetheless, considering the theoretically conservative nature of UKAs and their greater availability relative to TKAs, their revision rates remain within acceptable limits [10]. In the right patient population, properly implanted UKAs can even surpass the long-term performance of TKAs [11].

However, the technical demands of UKA exceed those of TKA, necessitating careful considerations. Chief among these is the need to avoid overcorrection of the mechanical axis [12]. In contemporary UKA practice, advocates lean toward minimally invasive implantation techniques, which have added to the intricacies of achieving precise implant placement [13]. Recent studies have indicated that, in terms of radiological implant positioning and postoperative limb alignment, UKA may outperform computer navigation [14-18]. Although functional parameters of UKAs exhibited no significant disparities between non-navigated and navigated groups at the 2-year mark in one study [19], there remains a lack of published investigations exploring the extended benefits of computer navigation in UKA. This study's aim was to ascertain whether more precise implantation through computer navigation translates into improved mid- to long-term survival rates and enhanced clinical outcomes.

METHODS

Patients

This study performed a consecutive series of 60 primary medial unicompartmental knee arthroplasties (UKAs) involving 56 patients. Among these cases, 30 patients received UKAs without utilizing navigation, while the remaining 30 patients underwent UKAs with the assistance of navigation. A previous study previously examined these knees at average intervals of 9 months and 18 months. For the current study's objectives, the same patient cohort underwent comprehensive clinical and radiological evaluations once again. The radiological assessment methods and statistical analyses employed mirrored those utilized in the aforementioned study, while clinical outcomes were not re-evaluated.

Following the established Perth protocol, weight bearing long leg antero-posterior alignment views and CT alignment views were captured. Utilizing multiple 3-mm-slice images, the implementation of the Perth protocol [20] facilitated the acquisition of measurements in coronal, sagittal, and axial planes. Notably, the radiologist overseeing the assessment of both image sets remained unbiased with regard to the treatment modality employed in the earlier study. Employing the methodologies delineated by Kennedy and White, the precise zone on the tibial plateau where the mechanical axis intersected was methodically examined. During scheduled clinic appointments, patients were administered Oxford Knee Scores (OKS) questionnaires, which enabled the documentation of any knee-related symptoms and range of motion. To facilitate comparisons between the two groups, a Fisher exact test was employed, Kaplan-Meier survival analysis was utilized for the description of survivorship trends, and logrank tests were conducted to scrutinize differences in survivorship patterns between the two groups.

RESULTS

Out of the initial 60 knees, 6 patients underwent total knee replacement, while 2 were lost to follow-up (which was considered a failure in our survivorship analysis). Additionally, 4 patients opted not to participate, but both individuals were contacted by phone to confirm that the original UKA was still in place, and thus, they were counted as survivors. A total of 44 patients (constituting 48 knees) responded to the questionnaire, with 42 patients (comprising 46 knees) participating in both radiological and clinical assessments. In this cohort of 48 knees, 20 had undergone navigation-assisted procedures (18 of which were reviewed), while the remaining 28 were not navigated (with all 28 being reviewed). The average age within the navigated group was 58 years (ranging from 42 to 79), and the corresponding average age within the non-navigated group was 62 years (ranging from 45 to 72). Importantly, the age disparity between the two groups did not reach statistical significance. The follow-up durations spanned 6.8 years for the navigated group and 8.8 years for the non-navigated group (ranging from 6.5 to 7.5 years).

Survivorship

Out of the initial 56 patients (comprising 60 knees), a total of six patients underwent revision to total knee replacements; notably, all six revisions were within the navigated group. Specifically, four patients had their knees revised within one year due to persistent pain, while one patient's knee underwent revision after five years owing to disease progression. The cumulative survival rate at the 9-year mark stood at 88.9%.

Upon conducting a comparison of the survival curves between the navigated and non-navigated groups (76.8% vs. 100%), no statistically significant difference was observed ($p = 0.0626$).

Radiology

The weight bearing mechanical axis views and CT axis measurements displayed a strong correlation ($r = 0.909$), with 38 instances of agreement and 8 instances of disagreement. These disagreements typically emerged within adjacent zones, and their origin could potentially be attributed to the influence of weight bearing.

The point at which the mechanical axis traversed the tibial plateau was determined to be at 44.65% of the tibial width, accompanied by a standard deviation of 17.77%. Notably, no statistically significant distinction was found between the knees treated with navigation and those without navigation (44.6% vs. 44.6%; p = 0.97). However, it's worth noting that non-navigated knees exhibited a higher standard deviation in comparison (24.7% vs. 17.3%).

Utilizing the Kennedy zones classification, a total of 32 knees demonstrated favorable alignment (zones 2 and C). While navigated knees exhibited a higher likelihood of alignment (79% vs. 66%), this difference failed to attain statistical significance based on Fisher's exact test. An intriguing observation was the concordance between Kennedy zones across our previous and current studies in 20 knees, while discrepancies were evident in 26 cases. Within these 26 mismatches, the latest measurements predominantly fell into adjacent zones, possibly attributed to measurement inaccuracies or slight deterioration in the medial or lateral compartments. Among these cases, four knees exhibited significant degeneration in the lateral component, while another four demonstrated tibial component subsidence.

Clinical outcome

Among the 48 knees evaluated using the Oxford Knee Score (OKS), 36 knees achieved ratings ranging from good to excellent. The median OKS stood at 40 (with a range spanning from 24 for the lowest score to 96 for the highest), with a mean of 37.9 (SD 8). Notably, there were no significant score differences observed between the navigated and non-navigated groups.

Despite a relatively higher percentage of malaligned knees presenting poor to fair OKS (26% vs. 15%), we identified no statistically significant distinction between well-aligned and malaligned knees in terms of OKS. It's important to acknowledge that the limited number of patients within our study could potentially contribute to this outcome.

Our analysis revealed that alignment of the leg and range of movement exhibited no significant correlation in all but two knees. One patient from each group reported excellent results (OKS 45), while another patient (from the navigated group) reported poor results (OKS 18), both of whom exhibited a range of flexion less than 100 degrees. It's worth noting that due to the lack of pre-operative movement data recorded in every case, direct comparisons could not be drawn in this regard.

Table: 1 Alignment views showing the number of patients in Kennedy zones.

	NAVIGATED	NON-NAVIGATED	TOTAL
Zone 1	2	4	6
Zone 2	4	6	10
Zone C	10	12	22
Zone 3	2	6	8
Zone 4	0	0	0

DISCUSSION

Unilateral knee arthroplasty (UKA) stands as an appealing treatment choice for isolated medial compartmental osteoarthritis. Within a substantial segment of knee arthroplasty patients, the implementation of UKA can yield functionally superior outcomes akin to the native knee, all while reducing health service costs. Despite these advantages, the utilization of UKA has encountered a decline recently, attributed in part to the technical complexities of surgeries and the challenges associated with achieving precise implant placement, a factor pivotal for successful clinical results.

Within the scope of this study, we observed no significant differences in long-term survivorship or clinical outcomes when comparing navigated and non-navigated UKAs. Although there was a tendency toward higher proportions of well-aligned knees exhibiting good or excellent clinical outcomes, as well as a greater proportion of navigated knees displaying well-aligned knees, these trends did not achieve statistical significance. Our findings, although not statistically significant, suggest that enhanced implant positioning precision and reproducibility might not invariably translate into improved survival rates for TKAs.

Our previous study demonstrated that computer navigation contributed to a higher rate of knees achieving the desired leg alignment zone. While the current study presented a similar trend, the difference did not reach statistical significance using the same analytical methods. Among the knees examined, nine displayed minor changes in leg alignment over time, whereas four exhibited substantial changes. It's noteworthy that due to the availability of only the measurements from the previous study, distinguishing between actual deterioration and intra-observer error remains challenging for these minor changes.

It's important to acknowledge that the study's primary limitations arise from its relatively small sample size, leading to a reduction in statistical power. Although no statistically significant difference was evident in survival rates between the two groups (p = 0.0626), a more extended follow-up could potentially uncover significant disparities in favor of the non-navigated group. Despite both groups utilizing fully cemented, fixed bearing unicompartmental knee designs with similar principles, their implants were distinct. The transition from Allegretto to EIUS was necessitated by the introduction of the navigation system at our hospital, and this change may have influenced our results, given the learning curve associated with computer navigation. Furthermore, it's important to acknowledge that the EIUS was relatively novel at the time of introduction, without the support of long-term registry data. The potential impact of higher revision rates for EIUS, as reported by the latest National Joint Registry could have influenced our survival analysis. Notably, due to the staggered introduction of navigation for our cohort compared to the non-navigated group, the ranges of follow-up periods do not overlap. Consequently, the outcome measures were collected on average two years apart, potentially attributing any differences to the natural progression of the disease.

CONCLUSION

Having undergone average follow-up periods of 6.8 years and 8.8 years, respectively, this study did not reveal any discernible differences in survivorship, radiological alignment, or Oxford Knee Score (OKS) outcomes between navigated and non-navigated UKAs. To establish whether component alignment genuinely acts as a predictive factor for favorable clinical results and to validate the routine application of computer navigation in UKAs, it becomes essential to undertake more extensive follow-up evaluations encompassing larger cohorts of patients.

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