

# Total knee arthroplasty for primary knee osteoarthritis: changing pattern over the past 10 years

CME

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**Objective** To review the epidemiology of total knee arthroplasty for primary osteoarthritis and the change of patient characteristics over the last decade.

**Design** Retrospective review.

**Setting** A tertiary referral centre for joint replacement surgery in a teaching hospital in Hong Kong.

**Patients** All patients who underwent primary total knee arthroplasty for primary knee osteoarthritis from January 2000 to December 2009.

**Results** In all, 1157 total knee arthroplasties (589 left and 568 right) were performed on 588 females and 162 males. The annual number of total knee arthroplasties increased from 91 in 2000 to 181 in 2009. The annual number of patients increased from 58 (46 female, 12 male) in 2000 to 159 (117 female, 42 male) in 2009. When compared yearly results, there were no significant changes in the preoperative Knee Society Knee Score, Knee Society Functional Assessment, and passive range of motion of these patients. However, there was a significant decreasing trend with regard to lower limb mechanical axis mal-alignment, from 15.1° deviation from the neutral axis in 2000, to 14.8° deviation in 2004, and then 12.9° deviation in 2009 (mostly varus deformity). There was no difference between left knees and right knees, and between females and males. The mean age of the patients did not show significant change over the past decade, but the number and proportion of patients over 80 years old showed an increase from 4.8% (2000 to 2004) to 13.8% (2005 to 2009). On the other hand, the number and proportion of patients under the age of 60 years did not change.

**Conclusions** There was an increasing trend towards total knee arthroplasties, both in terms of number of operations and patients. The number of younger patients having total knee arthroplasty did not increase over the last 10 years, whereas the number of those older than 80 years increased significantly over that period.

## Introduction

Knee osteoarthritis (OA) is a leading musculoskeletal cause of disability in elderly persons around the world. In the US, 12% of adults aged more than 65 years have symptomatic knee OA.<sup>1</sup> The Beijing Osteoarthritis Study showed that the prevalence of radiographic OA was 43% in Chinese women and 22% in Chinese men, and symptomatic knee OA occurred in 15% of women and 6% of men.<sup>2</sup>

Total knee arthroplasty (TKA) is a highly effective treatment for end-stage knee arthritis. The utilisation of TKA in the US increased by 69% from 1997 to 2005.<sup>3</sup> Similar trends have been observed in developed and developing countries globally.<sup>4-9</sup> Reports on the western populations also showed that the procedure was increasingly performed on younger patients.<sup>4-8</sup>

Hong Kong is a developed city with a population of 7 million. Local epidemiological data on TKA have not been published, however. Like other developed countries, we also face problems associated with a population made up of an increasing proportion of older persons. Thus it is expected that knee OA is likely to become an increasingly major public

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health issue and that recourse to TKAs will continue to increase. Using data collected from our tertiary referral centre and university teaching hospital, we looked into the incidence of TKAs by age and gender, changes in disease severity, and TKA utilisation trends for primary knee OA from 2000 to 2009.

## Methods

Records of all patients undergoing TKA for primary knee OA in Queen Mary Hospital (QMH), Hong Kong from 2000 to 2009 were identified, after exclusion of revision TKAs and for procedures other than for primary OA. All records were reviewed by the first author.

Patients were categorised according to whether they were aged less than 50, 50-59, 60-69, 70-79 and 80 years or above at the time of TKA. Their preoperative functional status was evaluated using the international Knee Society Knee Score (KSKS) and Knee Society Functional Assessment score (KSFA). The passive range of motion (ROM), which is a category of the KSKS, was also documented to reflect OA severity.

All patients had standing preoperative radiographs of the whole lower limb, that is, a single weight-bearing film that included the hip, knee, and ankle joints. Lower limb mechanical alignment was measured, and comparisons were made between the results of patients operated on in the years 2000, 2004, and 2009.

The annual incidence of TKAs was calculated by dividing the total number of patients having TKAs by the size of population under the care of Hospital Authority's Hong Kong West Cluster (HKWC) of each year. The population information was obtained from the Census and Statistics Department of the Hong Kong SAR Government. For comparisons between men and women, left and right knees, continuous variables were tested using independent *t* tests. For comparing changes in patient characteristics in different years, one-way analysis of variance tests were used. Significance was assumed at a 95% confidence interval, with a *P* value of less than 0.05.

Using the Clinical Data Analyses & Reporting System (CDARS), similar data on TKAs performed in all Hospital Authority hospitals from 2000 to 2009 were obtained and compared with our own results.

## Results

From 2000 to 2009, 1157 TKAs were performed in QMH for primary knee OA; 589 (51%) were left-sided and 568 (49%) right-sided. The total number of patients was 750; 588 (78%) were female and 162 (22%) were male. A total of 301 patients (250 females, 51 males) received one-stage bilateral TKAs, 106 patients (84

## 過去10年間因原發性骨關節炎而接受全膝關節置換術的病人的轉變模式

- 目的** 回顧因原發性骨關節炎而進行全膝關節置換術 (TKA) 的比率, 及於過去10年間患者特徵的轉變。
- 設計** 回顧研究。
- 安排** 香港一所教學醫院中負責人工關節替換術的三級轉介中心。
- 患者** 2000年1月至2009年12月期間所有因原發性骨關節炎而接受TKA的病人。
- 結果** 研究期間共進行了1157宗TKA, 其中左腳589例, 右腳568例; 588名病人為女性, 162名為男性。TKA每年的數目由2000年的91宗升至2009年的181宗, 而同期患者數目亦由58名 (46女, 12男) 升至159名 (117女, 42男)。比較每年的資料發現, 無論在術前膝關節學會評分、膝關節學會日常生活功能評分及踝膝被動關節活動度方面都無顯著的改變。可是對於下肢機械軸不正的程度, 卻隨着時間有明顯下降的趨勢: 由2000年只有離中軸15.1°, 降至2004年的14.8°, 再降至2009年的12.9° (大部份為膝內翻變形)。左膝與右膝, 以及患者性別並無顯著差異。雖然過去10年間患者的平均年齡無明顯差異, 但80歲以上患者的數目及比例均有上升的趨勢, 由2000至2004年的4.8%升至2005至2009年的13.8%。同時, 60歲以下患者的數目及比例卻沒有改變。
- 結論** TKA的宗數及接受TKA的患者數目有上升趨勢。在過去10年間, 接受TKA的較年輕患者未見增加, 反之, 接受TKA的80歲以上的年老患者明顯上升。

females, 22 males) received staged bilateral TKAs, 343 patients (254 females, 89 males) received unilateral TKAs.

The number of TKAs increased from 91 in year 2000 to 181 in 2009. The number of patients increased from 58 in 2000 to 159 in 2009 (Fig 1a). Similar proportional increases were observed in both left and right knees, and in men and women. The annual incidence of TKAs per 100 000 inhabitants was relatively static from 2000 to 2008, but showed a surge in 2009 (Fig 1b). The information from CDARS was also comparable to our own observations (Fig 1c). In 2000, the total number of TKAs performed in the Hong Kong SAR was 721 (in 641 patients) and increased to 1229 (in 1174 patients) in 2009.

The mean age of all patients, males and females, at the time of operation showed no significant change over the last decade (*P*=0.595) [Table, Figure 2]. Compared to the first 5 years, more patients (men and women) over 80 years of age received TKAs in the second 5 years. However, the proportion of patients aged less than 60 years showed no significant change. Data from the Hospital Authority also showed a gradual increase in the proportion of octogenarians

TABLE. The mean ages (years) of all patients, males and females, encountered over the last decade

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Total	69	67	70	69	69	70	70	70	71	70
Female	69	67	70	69	70	69	69	71	71	70
Male	70	69	70	67	67	75	75	68	70	71

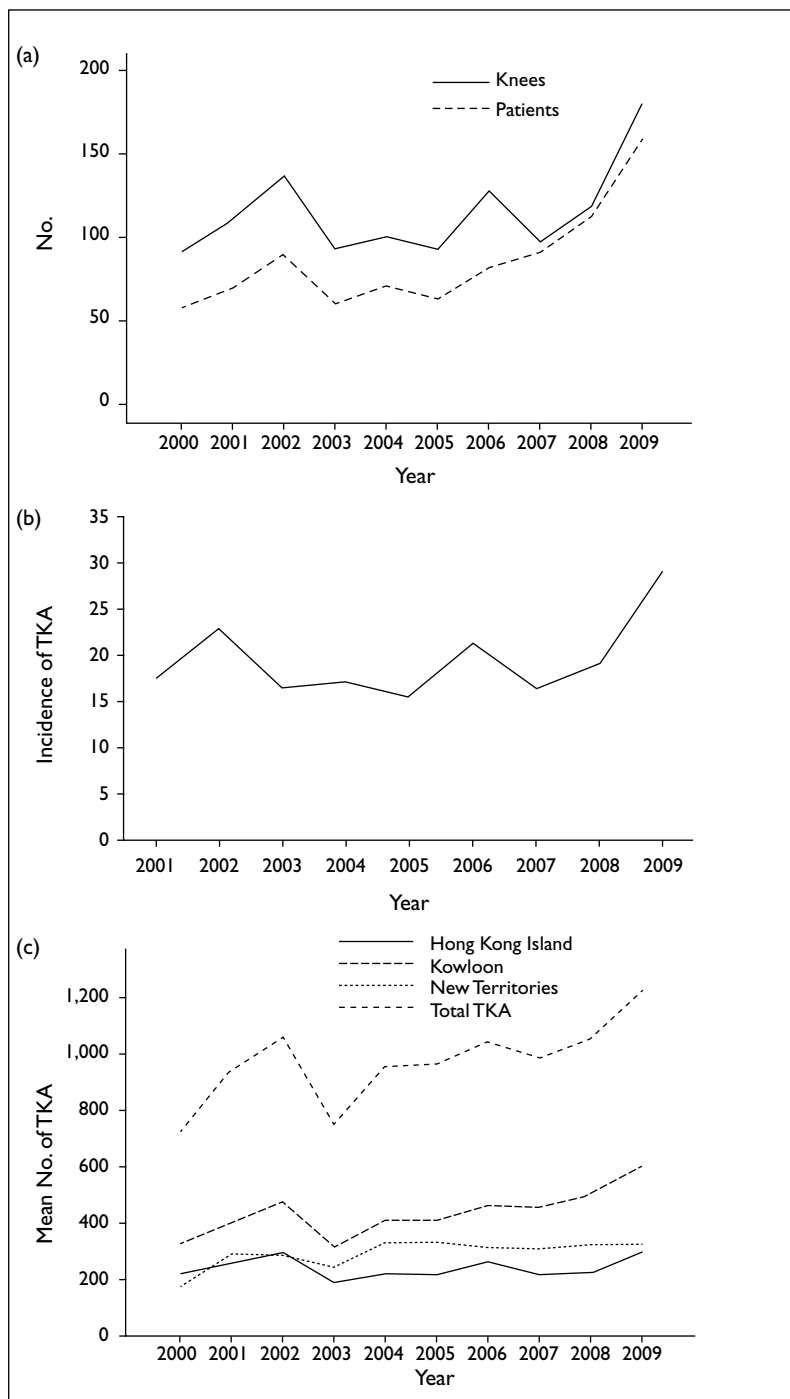


FIG 1. (a) The number of knees and patients operated from 2000 to 2009: there was an increasing trend in both. (b) The incidence of total knee arthroplasty (TKA) per 100 000 inhabitants was relatively static from 2001 to 2008, but then showed a surge in 2009. The overall incidence was still low compared with the western countries. (c) Information from the Clinical Data Analyses & Reporting System of Hospital Authority shows that more and more TKAs were performed all over Hong Kong

receiving TKAs during the same period of time (4.1% in 2000 and 8.4% in 2009; Fig 3), but not as rapid as in QMH.

The preoperative KSKS, KSFA, and ROM did not change over the last decade (Fig 4). Most of the patients had varus knee deformities. Valgus deformity only constituted a small part (4% in 2000 and 2004, and 6% in 2009). Lower limb mechanical alignment (deviation from the neutral axis) decreased slightly from 15.1° in 2000 to 14.8° deviation in 2004, and 12.9° deviation in 2009, but was statistically significant (P=0.019). Although functional status and severity of patient symptoms did not change, the preoperative radiographic severity of OA showed alleviation.

There was no significant difference between left and right knees (in men and women) in terms of preoperative KSKS, KSFA, ROM, and mechanical alignment. The number of female patients constantly outnumbered their male counterparts, the proportion of the latter increased from less than 20% early in the decade, to over 26% in the last 3 years (Fig 5a). Overall, gender distribution pertaining to the Hospital Authority data was similar, but unlike QMH trends, there was no increase in the proportion of male patients in recent years (Fig 5b).

## Discussion

Using the joint replacement surgery database in QMH, we analysed the longitudinal trends in the utilisation of TKAs and patient characteristics over the last decade. To the best of our knowledge, no similar reports have been published on local data. Queen Mary Hospital is the leading hospital in HKWC and serves inhabitants in the central and western district, and the southern district; 33% of whom were aged 50 years or above in 2009.

### Do Chinese people need less total knee arthroplasties?

Although the total numbers of TKAs doubled and patients tripled from 2000 to 2009, the overall incidence of TKA per 100 000 inhabitants was still relatively low (29 in 2009) compared with developed western countries, including Sweden (2008),<sup>7</sup> Norway (2007),<sup>4</sup> and Canada (2006-2007)<sup>6</sup> where it exceeded 100 per 100 000 of the population. Possible reasons for such a discrepancy were that fewer Chinese suffer

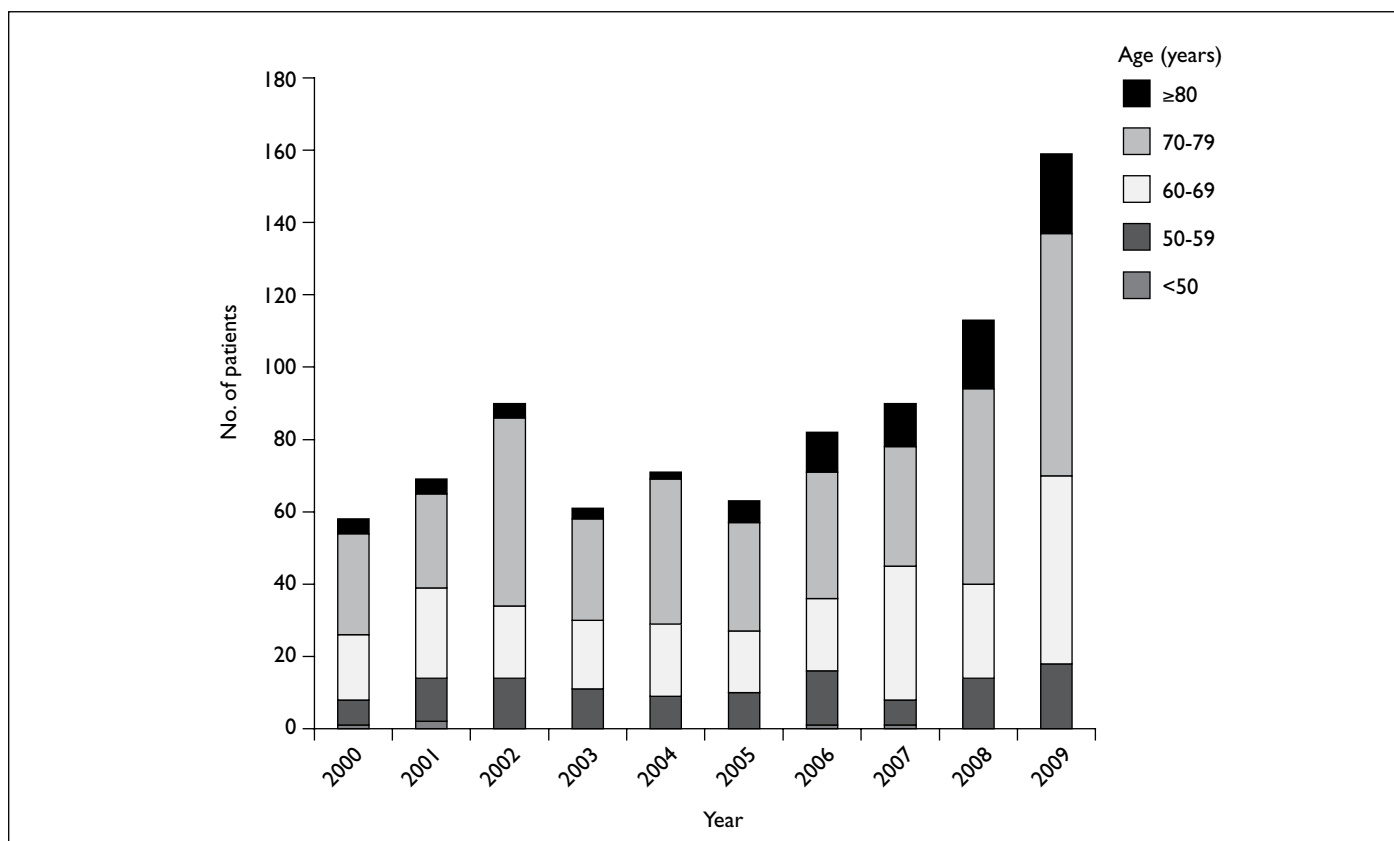


FIG 2. Apart from the increase in the total number of patients, the number of patients over 80 years old also significantly increased in the latter half of the decade, but the number of patients below 60 years old remained unchanged

from knee OA, or that TKA was less well accepted by local patients.

Hoaglund et al<sup>10</sup> studied the radiographic prevalence of knee OA in 500 hospitalised patients in QMH in 1967. Using the Kellgren Lawrence grade 3 or above as the cut-off, they found a prevalence of 5% in local men and 13% in local women. Recent reports of population-based studies in Beijing and Shanghai revealed that the prevalence of knee OA in Chinese people was similar, if not higher than that in their Caucasian counterparts.<sup>2,11</sup> There was no good explanation for the drastic increase, but current evidence proved that the Chinese population did not differ from the western populations in terms of the prevalence and severity of knee OA.

The traditional Chinese belief in bodily conservation may deter some elderly patients from having TKAs, but the public's acceptance of the operation is certainly increasing. The growing waiting list for TKA in QMH speaks for itself. With nearly 700 knees on the list, the mean waiting time is now 3 years. More and more patients are being enrolled every year; the demand certainly outstrips the supply. The seemingly low incidence of TKA in Hong Kong may partly be due to limitation of medical resources, as costs of the operation in public hospitals are totally

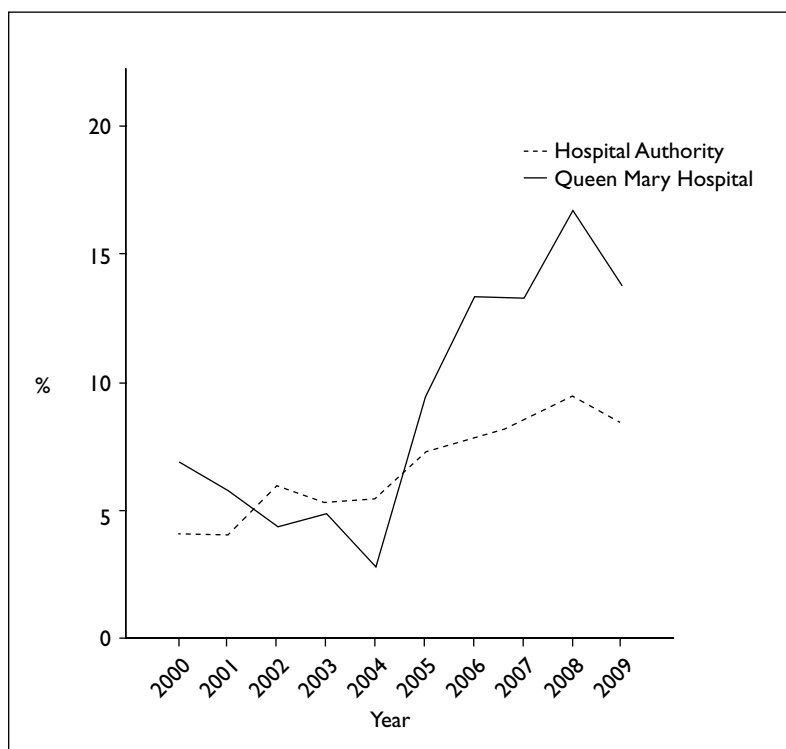


FIG 3. An increasing trend of octogenarians receiving total knee arthroplasty was observed in Queen Mary Hospital and in the Hong Kong SAR (according to Hong Kong Hospital Authority data)

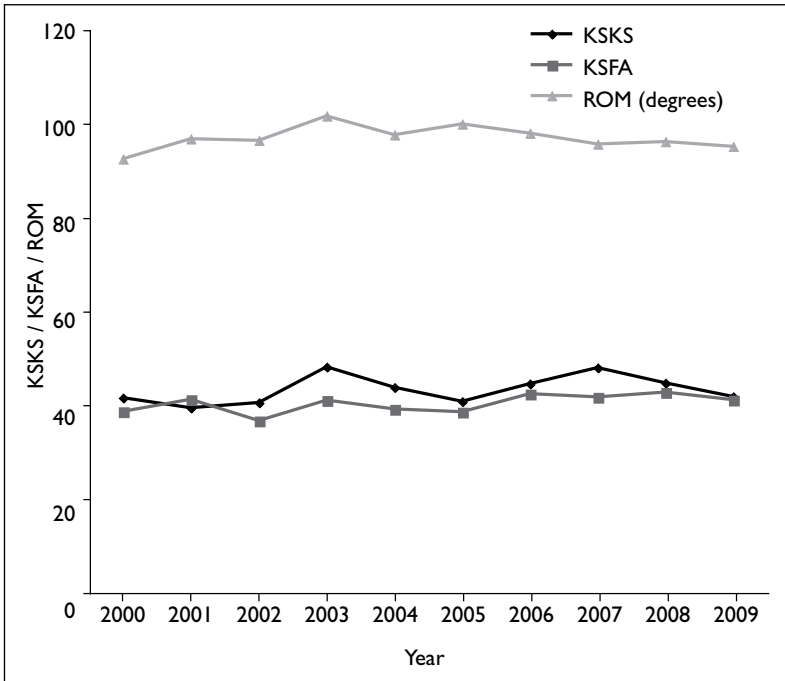


FIG 4. The preoperative Knee Society Knee Score (KSKS), Knee Society Functional Assessment score (KSFA), and range of motion (ROM) over the last decade

covered by the government.

**Are our patients getting younger?**

There was no significant change in the overall mean age of female and male patients over the last 10 years.

The number and percentage of patients aged younger than 60 years remained relatively static, while those aged 80 years or above increased.

Data from the western countries have revealed a rapid increase in TKA rates among young patients (US, Canada, Sweden, Norway),<sup>4,6-8</sup> while the increase in the older age-groups was less marked. We did not encounter such a surge in young patients having TKAs, but an increasing trend was evident in older patients. Fundamentally knee OA is a degenerative disease, ie age is the biggest risk factor. Younger people simply have less knee OA. On the other hand, the long waiting lists can partially be responsible. Even though patients were enrolled at an earlier stage, by the time they finally receive the operation, they were already a few years older. Patients aged more than 80 years can also benefit from TKA owing to better anaesthetic and perioperative care, improved surgical techniques and implant design/materials.

**Are we operating on patients with less severe diseases?**

If TKA is becoming more popular, most of the patients with end-stage degeneration would have been operated. Theoretically we should therefore be operating on patients with less severe disease, higher functional scores, and less deformity. However, according to their preoperative KSKS, KSFA, and ROM, the severity of pain and limitation of function did not decrease in the last decade, although lower

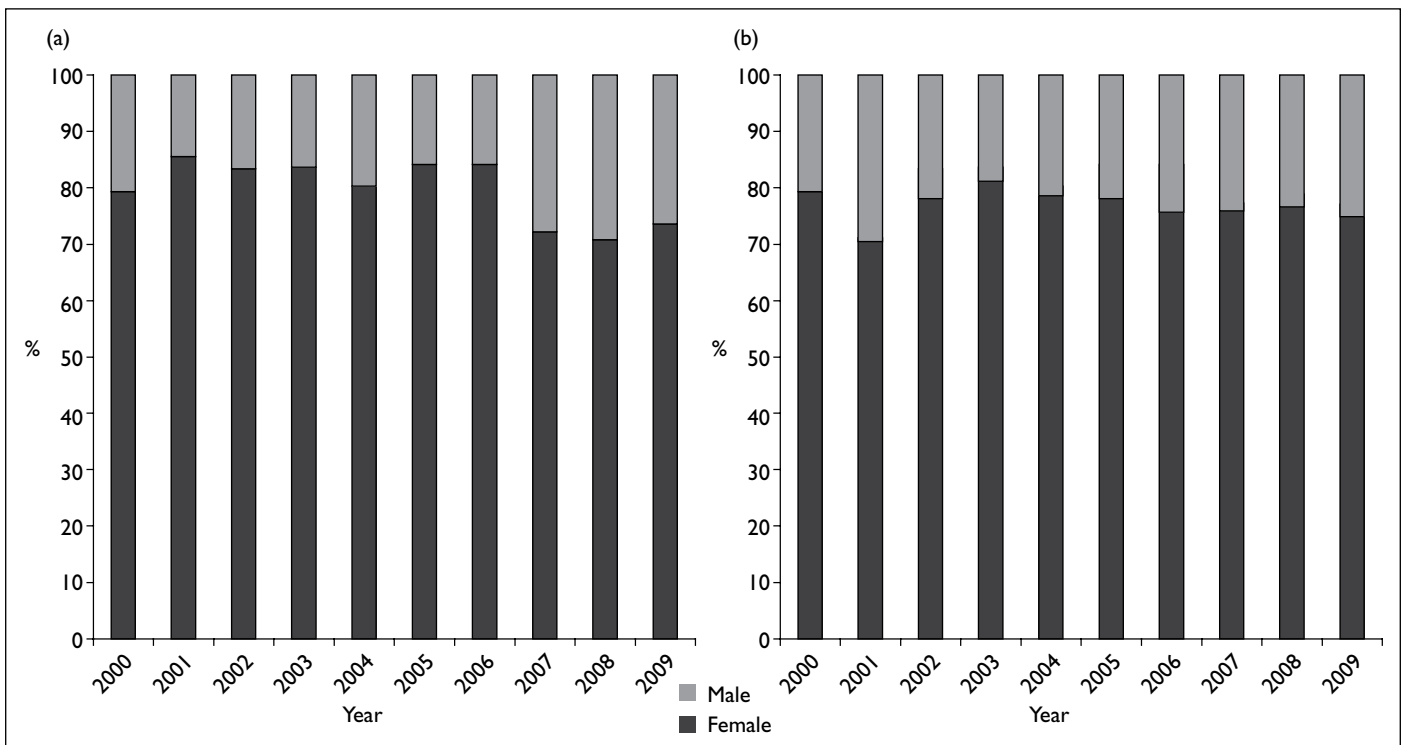


FIG 5. (a) The proportion of male patients increased in the years 2007, 2008, and 2009 in Queen Mary Hospital. (b) The proportion of male patients in Hong Kong SAR

limb mechanical mal-alignment did improve over the period 2000 to 2009.

The long waiting lists and the relatively low incidence of TKA in Hong Kong can explain this observation. Patients used to wait for 1 to 2 years for TKA in 2000, but have to wait for 3 to 4 years now. By the time of the operation, their symptoms and functions are liable to deteriorate compared with the time of enrolment. A lower incidence of TKA also means that many patients in the community with significant degeneration that otherwise warrant replacement are not operated on. Their functional scores may not improve until they receive a TKA.

### Are men and women, left and right equal?

The number of left TKAs (589) was slightly more than that on the right (568). We did not find any difference between the two sides in terms of functional scores and mechanical alignment. Some authorities believe that knee OA is more common on the right side because it is the dominant limb. This postulation was not proved in our study, possibly because the sample size was too small to demonstrate a statistically significant difference. Most of our patients suffered from advanced OA, and so represented persons at one end of the disease spectrum. Almost all of them had poor preoperative function.

Most epidemiological studies showed that female gender is a risk factor for OA. The underlying mechanism is not fully understood. One theory is that sex hormones are involved in the pathogenesis of the disease. Reports from arthroplasty registries in Australia, Canada, Norway, and Sweden all showed that females outnumbered the male patients,<sup>4,7</sup> with a ratio roughly of 1.5 to 1. The ratio reported from South Korea was even higher, as 7.4-8 to 1.<sup>9</sup> The authors attributed this observation partly to kneeling and squatting habits in South Korean women.

We also had a greater proportion of female

patients. The gender ratio was between 3.8 and 5.9 over the period 2000 to 2006, but from 2007 to 2009, we had a greater number of males. The gender ratio dropped to 2.6-2.7, but has not reached that of developed countries, although a similar trend is evident. Hospital Authority data from CDARS, however, did not show an increasing proportion of male patients having TKAs, the gender ratio having remained relatively static (3.8 in 2000 to 3.0 in 2009; lowest value 2.4 in 2001 and highest 4.3 in 2003).

Why did fewer local men receive TKAs than women? Apart from the fact that less men suffer knee OA, the resulting symptoms appear to be less severe/better tolerance in men, alternatively the shorter life span of men may be a factor. In 2006, the average life expectancy of Hong Kong men was 79.4 years as opposed to 85.5 years for women. Thus, in the elderly population, females predominate. Moreover, traditionally Chinese men may be more reluctant to have operations. We, however, found no significant difference between men and women in terms of the preoperative functional scores and radiographic mal-alignment.

### Conclusion

From 2000 to 2009, an increasing trend in the number of patients and knees operated on was observed in QMH. The mean age of the patients did not change, nor did we operate on more patients aged less than 60 years. However, more patients aged more than 80 years had TKAs in the last 5 years of the studied period. The proportion of male patients increased in the last 3 years of the study period. Postoperatively, we achieved radiographically less deformed knees, as evident by the lower limb mechanical alignment. Preoperative functional scores of the patients did not change with time, nor was there any significant difference between men and women, and left and right knees.

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