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Perspective

Joint replacement surgery in the Armed Forces Medical Services, India: The journey so far and looking ahead

Introduction

Joint replacement surgery, also called replacement arthroplasty, is an orthopedic surgical procedure wherein an arthritic or dysfunctional joint surface is replaced with a joint implant. Joint replacements are one of the greatest success stories in the history of medical science. Almost all human joints have been replaced. Amongst these, total knee replacement (TKR) and total hip replacement (THR) are the most commonly performed procedures. Efforts from as early as the 17th century have been made to achieve success in hip replacement surgery with various materials such as silver plates, magnesium, zinc, glass, celluloid, de calcified bones, wax etc.¹ One of the earliest recorded successful attempts at THR using an ivory ball – socket joint and nickel-plated implants was reported by Professor Themistocles Gluckin in 1891.² These early experimental days were the pioneering attempts which led to later surgeons' successful attempts at hip replacement surgery.

The evolution of knee joint replacement is equally fascinating. Shiers is considered the pioneer of knee replacement surgery and his original work was published in 1954.³ Since then, with better understanding of physiological dynamics of knee joint as well as improvement in metallurgy, operative techniques as well as types of implants used have undergone a sea change. The condylar knee designs have been further improved to include modularity and non-cemented fixation with the use of universal instrumentation.⁴ Many types of implants are currently used for total knee arthroplasty. Types of implants that are most commonly being used in primary total knee arthroplasty are: posterior cruciate ligament-substituting implants; implants with ceramic components; posterior cruciate ligament-retaining implants; mobile-bearing implants; nonmodular implants, compression-molded polyethylene implants and medial-pivot implants.⁵ TKR will continue to evolve as there are exciting developments in the fields of navigation-guided surgery, evolutions in enhanced kinematics and development of wear-resistant bearing surfaces with better fixation.

Armed Forces Orthopedic Surgeons were some of the first to adapt to this exciting new field. The first joint replacement surgery was performed by Maj Gen D Mukherjee in 1981, as per records available in the office of the Director General Armed Forces Medical Services (DGAFMS) and the first fully functional joint replacement center (JRC) was established at Military Hospital Kirkee on 27 Aug 1981. The second fully functional JRC was established at the Army Hospital (Research & Referral) at Delhi in 1999. During the last decade, a number of JRCs have been established, notably amongst them are Command Hospital (Air Force) Bengaluru, Base Hospital Delhi Cantt and Base Hospital Lucknow. As on date, no less than twenty orthopedic centers across the Armed Forces Hospitals are practicing joint replacement surgery. Currently, there is no formal joint registry in the Armed Forces Medical Services (AFMS). There is also no government mandated or otherwise Pan-India National joint registry in India. The most comprehensive data bank akin to a joint registry is maintained by Indian Society of Hip and Knee Surgeons (ISHKS), a registered charitable Trust, with 42 arthroplasty surgeons across India as its current members.⁶ It is a felt need that results of our joint replacement programs be reviewed and the lessons learnt be implemented to improve the said programs.

The journey so far...

As pointed out earlier, no formal joint registry exists in the AFMS as on date. However, the office of DGAFMS has endeavored to create an informal database which is based on inputs received from all the orthopedics centers which are practicing joint replacement surgery. Based upon this one can trace the timeline and trends in joint replacement surgeries in the AFMS till date.

The total number of THR and TKR carried out (up to Aug 2014) in the Armed Forces so far is 1227 and 2614 respectively. The male to female ratio is 2.3:1 for THR and 1.9:1 for TKR. Median age is 58 and 64 for THR and TKR respectively. The age distribution of cases for THR and TKR is shown in Fig. 1. This data is similar to ISHKS registry data where average age for

Fig. 1 – Age distribution of patients of Total Hip Replacement (THR) and Total Knee Replacement (TKR).

THR was 52 years and a male to female ratio of 1.5:1 and average age for TKR was 64.4 years and a male to female ratio of 1:4.3.

It is noted that the number of surgeries being done has shown a steep climb in the last decade (Fig. 2). There are multiple factors contributing to rapid amplification of joint replacement surgeries in AFMS hospitals. Important ones are listed as following

- (i) Exposure of the surgeons to joint replacement surgery at residency level.
- (ii) Liberal policy regarding study leave and in-service training which encourages young orthopedic specialist to learn more in this field.
- (iii) Liberal local purchase procurement policy of the AFMS.
- (iv) Increasing clientele knowledge and demand.

This, along with the fact that intense competition amongst manufacturing companies has driven the cost of implants down, has made it easier for heads of respective military hospitals to procure implants.

It is seen that traumatic injuries to hip joint or sequel of the same forms the most common indication (38%) for THR in our population (Table 1). Avascular necrosis (AVN) of hip and arthritis account for 22% and 31% respectively of all cases of THR. This is in contrast to ISHKS data reported by Pachore et al⁶ where traumatic injuries account for lesser proportion (13.6%) than AVN (49%) and arthritis (19%). This may be attributable to the nature of occupation of our soldiers who are more prone to hip injuries than civilian counterparts.

THR done for failure of previous replacement arthroplasty or because of failure of implants account for a minority of indications (3%). It has been noted that revision THR form

Fig. 2 – Number of cases done [1998–2014]. THR: Total Hip Replacement. TKR: Total Knee Replacement.

Table 1 – Indications for total hip replacement.

Diagnosis	Number of cases (n = 1227)
Avascular necrosis hip	276
Primary osteoarthritis	281
Post traumatic osteoarthritis	87
Rheumatoid arthritis	13
Fracture neck femur/Non union neck femur	366
Intertrochanteric fracture	99
Pathological fracture	14
Tuberculosis Hip	13
Post Infectious arthritis	9
Old perthes disease	4
Aseptic loosening/Failed THR	18
Infected THR	11
Failed bipolar prosthesis	3
Others	33

12–21% of case load in centers who have longstanding joint replacement programs.⁷ Hence it may not be incorrect to assume that number of revision THRs are expected to increase over the period of time as long term results of previously done THRs at our centers start materializing.

Primary osteoarthritis is seen to be the main indication for TKR (94%) [Table 2]. ISHKS data⁶ too indicates that osteoarthritis is the indication for TKA in 97% cases. Bone tumors involving distal femur or proximal tibia account for 2% of all TKRs. TKRs in these cases are part of limb conservation strategy. With newer chemotherapeutic agents and radiotherapy techniques (Image guided radiation therapy and intensity modulated radiation therapy) available, incidence of limb conservation is expected to rise in bone tumors and will possibly form an increased percentage of TKR in future. As in THR, revision TKR for complications from previous TKR account for 2% of all cases. As explained previously, this number too is expected to rise over the period of time. Interestingly, it is seen from ISHKS data⁶ that rheumatoid arthritis and related inflammatory arthritis account for 3.2% of cases of TKA while our data shows that these cases account for a mere 0.8%. This may give rise to the thought that possibly there may be a proportion of patients of inflammatory joint conditions who

would benefit with joint replacement surgeries if a good co-ordination between rheumatologist and orthopedic surgeons exists.

Superficial surgical site infection and wound dehiscence seem to be commonest peri-operative complications in both THRs and TKRs (Table 3). These have been treated conservatively and resolved without any sequel. However, there is a small but definite incidence of deep site infection of implant and of implant displacement which required revision TKR. It is to be noted that data about early complications was available for only 1731/2614 (66.3%) cases of TKR and for 796/1227 (64.8%) cases of THR. Hence it is difficult to draw an estimate of actual incidence of peri-operative complications in our patient population.

Selection of the correct implant is guided by age of patient, his/her functional requirement in post-operative period and survivorship data of implant as mentioned in the literature. The cost and availability too is an important consideration. The choice of implants used in AFMS is illustrated in Fig. 3. Pachore et al⁶ indicate that the prevalence of cemented TKA is absolute with no cases using uncemented total knee prosthesis. Also that uncemented prosthesis account for 65% while cemented prosthesis account for 17% of all THR. Unfortunately, the type of implant used in our hospitals is inadequately documented. No details are available for 73% of all cases (Fig. 4).

The way ahead...

In India itself, almost 70,000 joint replacement surgeries were performed in the year 2011 alone.⁶ Though in absolute numbers the total number of joint replacement surgeries done cumulatively in the AFMS hospitals may seem small but it is imperative to remember that the AFMS orthopedic surgeons strive to deliver the correct treatment protocol on evidence based management guidelines, without any commercial considerations. Patients presenting for joint replacement surgeries are discussed in joint clinics and are offered the same only when absolutely indicated. This has got an additional benefit of very low rates of complications noted in our patient population, especially as regards to re-surgery rates. The demand for joint replacement surgery is set to rise further. This is so because of the fact that there is increased longevity, more awareness and confidence in the clientele and desire for more active lifestyles even in veterans and families.

Long term results in joint replacement depend on many factors – patients, surgeons and implants. It is known that male gender and young age increase the chances of aseptic

Table 2 – Indications for total knee replacement.

Diagnosis	Number of cases (n = 2614)
Primary osteoarthritis	2456
Post traumatic arthritis	17
Rheumatoid arthritis	21
Post infectious arthritis	05
Infected TKR	26
Aseptic loosening/failed TKR	31
Periprosthetic fracture	04
Aneurysmal bone cyst distal end femur	03
Osteosarcoma distal femur	16
Giant cell tumors distal femur/proximal tibia	17
Other neoplasms of distal femur/proximal tibia	07
Others	11

Table 3 – Incidence of peri-operative complications.

Complication	Number of cases
Superficial surgical site infection	19
Deep infection/Infection of implants	06
Wound dehiscence	03
Deep vein thrombosis	03
Implant displacement	02
Pulmonary thromboembolism	04

Fig. 3 – Percentage proportion of Implants used, company wise.

loosening and consequently the risk for revision. However it is the quality of the surgical technique that is the most important factor for reducing the risk of aseptic loosening. It has been recognized that the variations in the type of surgical technique used amongst hospitals is a singular factor significant enough to cause a 100% difference in revision rate for aseptic loosening.⁸ The expertise of the surgeon and the team is a key factor determining the complication and failure of a joint replacement. Studies indicate that hip and knee replacements surgeries performed by inexperienced surgeons have overall poorer results and 11 times more likely to fail than those done by an experienced surgeon.^{9,10} To enhance quality of surgery, it is essential that variability is reduced between centers and this can be achieved if a minimum standard framework is universally applied across all centers practicing joint replacement. These minimum standards should include following aspects:

1. Standardized preoperative processes which should include minimum standards for eliciting medical history, assessment of risk factors and should include patient education

Fig. 4 – Percentage distribution of types of implants used in THR and TKR.

2. Standardized intra-operative processes, which should include for the prophylactic use of antibiotics, instrumentation and implants used and careful documentation of the technique used
3. Standardized post-operative processes, such as minimum standards for follow-up clinical care as well as documentation of final range of movements achieved
4. Standards for the selection of devices and the use of new technologies
5. Minimum staff required
6. Standardized surgeon training, including refresher training
7. Standard protocols for documenting peri-operative, early as well as late complications of the replacement surgery

To this end, the AFMS has introduced a number of measures. The training of young orthopedic surgeons is being standardized across the centers. They are encouraged to opt for attachments or short term courses at centers of excellence. There is also an option for them to opt for in-service training or formal training (study leave) in joint replacement surgery. Staffing and infrastructure of the various centers is being constantly upgraded. Patients are kept in-hospital to ensure they receive optimal post-operative physiotherapy. Procurement process for implants and ancillary instrumentation is being simplified. The cumulative goal of these exercises is to deliver optimum quality management in patients undergoing joint replacement surgery.

As has been seen in our data, a variety of implants have been used in our patient population. Analysis of international registry data indicates that implants have variable outcomes. While most perform well, some have outcomes less than what would be regarded as acceptable. They have a higher than anticipated rate of revision surgery when compared to all other implants in their class. These are referred to as “outlier” implants. This variability in implant performance highlights the need for vigilant post-surgery surveillance.¹¹ Labek et al¹² conducted a systematic review of worldwide revision rates after joint replacement which are calculated as revisions per

100 observed component years. A mean of 1.29 revisions and 1.26 revisions per 100 observed component years was seen for hip replacement and knee replacement surgeries respectively. Authors also noted that the outcomes of total hip and knee replacement are almost identical. The authors conclude that revision rates of about 6% after five years and 12% after ten years are to be expected. Such a systemic review from pooled data obtained from international registers helps joint replacement programs set a benchmark for practice. Unfortunately, patient population served by AFMS hospitals is what is typically called a "floating population". Hence implants which have been placed at one center may present as "failure" in a different center. Failures of any implant needs to be established early to reduce patient morbidity and mortality from their continued usage. The clinical impact of implant failures can be minimized with prompt reporting and ongoing data collection through registry.¹³ This emphasizes the need to have a central database, or a joint registry in the AFMS. A central databank, or Joint Registry, is recommended to have, but not limited to, following quality measures.¹⁴

1. Annual hospital volume
2. Patient demography and indication for surgery
3. Procedure and site
4. Type of implant used
5. Annual surgeon volume
6. Average length of hospital stay
7. Antibiotic prophylaxis
8. Inpatient prophylaxis for deep vein thrombosis
9. Dedicated joint services: availability and type
10. Inpatient mortality rate
11. Peri-operative complication rate

With the establishment of a joint registry it will be possible to pool in data from all centers practicing joint replacement. It would then identify differences in outcome based on patient, surgery or implant specific factors. One may argue that the Armed Forces generate a relatively small number of joint replacements yearly (<1500 per year). Hence, it may take a very long time to arrive at reasonable conclusions about implant and procedures and even then conclusions may not be realistic. Instead the same data can be contributed to the registry maintained by ISHKS which is a body which represents the large numbers of joint replacement surgeons and super-specialty joint replacement centers. The data generated by this body is very huge, realistic and represents national trend. Nevertheless, there are powerful arguments in support of an Armed Forces registry in that it can serve as internal monitoring of work load and follow-up at joint replacement centers, allow planning of financial allocations, guide administrative decisions on procurement and assessment of the sales and service support of the concerned company. AFMS already has some critical components in place to organize a successful and meaningful joint registry. They are enumerated as under:

Organization and finance

The majority of international registers are maintained by national orthopedic associations; others are driven by government institutions, as in England and Finland, or work in close

conjunction with federal health authorities, as in Canada. Most national registries are financially supported by government institutions such as national districts or health agencies.¹⁵ Similarly, AFMS draws its budget from the ministry of Defence, hence a AFMS joint replacement registry would draw funding from the same. The health systems in most countries offer a unique patient identifier which is assigned to each inhabitant. In the AFMS, the service number of individual serving/retired personnel serves the same purpose.

Documentation

Every registry collects data on hip and knee replacements except in Sweden and Denmark, where separate databases exist for each joint. Registries in Finland, New Zealand, Norway and Sweden record information on other joints, mainly the shoulder, elbow and ankle, but some also include finger and toe joints.¹⁶⁻¹⁸ In general, the dataset consists of patient identifiers, with the name, date of birth and gender, hospital identifiers and basic surgical data including the date of operation, the diagnosis, the surgical procedure and the implants used. The detailed case sheets written in AFMS hospitals on a routine basis captures all these components.

Data handling

The international registries offer one or more methods of documentation. The paper-based method is available in nearly every register while online access or other types of electronic data transfer is not offered by all. Paper forms can be used as proformas, helping to collect the required information before being entered electronically. In the AFMS, data handling of Joint Replacement Registry is, to some extent, incorporated into already existing system of Annual Specialist Returns.

Outcome dissemination

Surgeons receive regular feedback from the registries in nearly all countries and results are published as annual reports or scientific articles in orthopedic journals. In the AFMS, the Armed Forces Medical Research Committee is one such nodal agency for data collation and analysis. The results can be disseminated to all concerned through the Medical Journal Armed forces India.

To conclude, Joint Replacement surgery is a well-established and fairly common practice in the Armed Forces now. The joint replacement surgery program has grown by leaps and bounds in AFMS hospitals since its advent in 1981. With multifaceted improvements in training, infrastructure, staffing and procurement noted in the last decade, joint replacement program in the AFMS can be expected to be at par with the best in the world.

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Lt Gen B.K. Chopra, AVSM, PHS
 Director General Armed Forces Medical Services &
 Senior Colonel Commandant, O/o DGAFMS, Ministry of Defence,
 'M' Block, New Delhi 110001, India
 E-mail address: choprabhusan@yahoo.com

Available online 25 December 2014

<http://dx.doi.org/10.1016/j.mjafi.2014.12.012>
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