




Trends in Total Knee Replacement Surgery in Chile. How Are We Operating Them?

Tendencias en la cirugía de artroplastía total de rodilla en Chile. ¿Cómo las estamos operando?

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Abstract

Introduction Total knee replacement (TKR) significantly increased among the population in recent decades, and it shows great variation in its study and technique in different countries. There is no registered Chilean data to assess TKR implementation.

Objective To record the trends in TKR in different aspects within Chile and compare them with records from other countries.

Materials and Methods We conducted an email survey among knee surgeons in Chile considering four aspects: general features, preoperative study, surgical technique, and cementation technique. We excluded surveys not completed in full. The analyses included overall data and data per years of experience (YOE), and we compared the results with those of international studies.

Results We obtained 87 complete surveys. Most respondents performed 25 to 50 TKRs each year (44%), with only 16% performing over 75 TKRs. Only 20% used the ambulatory modality, while 43% believed patients always require hospitalization (especially surgeons with more than 10 YOE). Robotic systems were used by 18% of the surgeons, especially those with more than 10 YOE; the most used systems were ROSA and CORI. In total 90% of the respondents believed TKR should be part of the Explicit Health Guarantees (*Garantías Explícitas de Salud*, GES, in Spanish) program, with no differences in terms of YOE. A total of 81% used the posterior-stabilized (PS) system, 96% performed a medial parapatellar approach, 82% used an extramedullary tibial guide, 41% tended to replace the patella, and 35% did not use a tourniquet (none of the variables showed differences according to YOE). Only 31% used vacuum cementation (with a higher frequency in the group with fewer than 10 YOE), 95%

Keywords

- ▶ total knee replacement
- ▶ national survey
- ▶ surgical technique
- ▶ cementation technique

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placed cement on components and bone, 75% placed it in the keel, and 56% used finger packing (only 22% with a gun). The most common cementation sequence was tibia-femur-patella. In most aspects evaluated, we observed important differences compared with studies from other countries.

Conclusion There is a high variability in the performance of TKR in Chile, with different trends compared with those of other countries. Overall, there are no major differences in the surgical technique concerning YOE, although there is variation in the cementation technique and the use of robotic systems.

Resumen

Introducción La artroplastía total de rodilla (ATR), que ha tenido un aumento importante en la población en las últimas décadas, presenta una gran variación en su estudio y técnica entre los distintos países. En la actualidad no hay datos nacionales registrados que evalúen la forma de su implementación.

Objetivo Registrar las tendencias respecto de la ATR en distintos aspectos en Chile y compararlas con los registros de otros países.

Materiales y Métodos Se realizó una encuesta vía email a cirujanos de rodilla en Chile considerando cuatro aspectos: generalidades, estudio preoperatorio, técnica quirúrgica y técnica de cementación. Se excluyeron las encuestas que no fueron completadas por completo. Se analizaron los datos generales y separados según años de experiencia (ADE). Se compararon los datos con los obtenidos en estudios internacionales.

Resultados Se obtuvieron 87 encuestas completas. La mayoría de los encuestados realizaba entre 25 y 50 ATR en 1 año (44%), y el 16%, más de 75. Sólo un 20% utilizaba la modalidad ambulatoria, y un 43% creía que siempre deben ser hospitalizadas (mayor frecuencia en los cirujanos con más de 10 ADE). Un 18% utilizaba algún sistema robótico, con mayor frecuencia en cirujanos con más de 10 ADE; los sistemas más usados fueron ROSA y CORI. El 90% creía que la ATR debería ser parte del programa de Garantías Explícitas de Salud (GES), sin diferencias según ADE. El 81% usaba sistema estabilizado posterior (*posterior-stabilized*, PS, en inglés), 96% realizaba un abordaje parapatelar medial, 82% usaba guía extramedular tibial, 41% tendía a recambiar la patela, y un 35% no usaba torniquete (ninguna de las variables mostró diferencias según ADE). Sólo un 31% utilizaba cementación al vacío (mayor frecuencia en el grupo con menos de 10 ADE), 95% colocaba el cemento en componentes y en hueso, 75% colocaba en la quilla, y 56% utilizaba el dedo para colocarlo (sólo 22% con pistola). La secuencia más frecuente de cementación fue tibia-fémur-patela. En la mayoría de los aspectos evaluados, se observaron diferencias importantes con estudios de otros países.

Conclusión Existe una gran variabilidad en la realización de ATR en Chile, con tendencias distintas a las de otros países. En general, en relación con los distintos ADE, no hay grandes diferencias en la técnica quirúrgica, sí habiendo diferencias en la técnica de cementación y en el uso de sistemas robóticos.

Palabras clave

- ▶ artroplastía total de rodilla
- ▶ encuesta nacional
- ▶ técnica quirúrgica
- ▶ técnica de cementación

Introduction

Total knee replacement (TKR), one of the most frequent orthopedic surgeries in the world, improves the quality of life of patients with advanced-stage gonarthrosis.^{1,2} In Chile, the prepandemic TKR rate (2019) was of 28.2 per 100 thousand inhabitants, corresponding to more than 5 thousand procedures per year.³ The current waiting list for TKR in Chile is the second largest in the country according to the Chilean Ministry of Health,³ suggesting that both the TKR

rate and the absolute number of procedures must increase in the short term.

Some countries have national registries or information regarding the technique used for TKR (such as Australia, New Zealand, Norway, Sweden, the United States, and the United Kingdom).⁴⁻⁹ However, in Latin American countries, there are no national registries to help us understand our local reality. The only published record is from the Latin American Society of Arthroscopy, Joint Reconstruction, and

Sports Trauma (Sociedad Latinoamericana de Artroscopía, Reconstrucción Articular y Trauma Deportivo, SLARD, in Spanish), which encompasses several countries on the continent.¹⁰

The present study aimed to determine current TKR trends in Chile by analyzing different technical aspects among knee surgeons performing this procedure and comparing them with registries published by other countries.

Materials and Methods

We conducted a national survey concerning TKR for specialized surgeons working in Chile to know their experiences and preferences. The survey was composed of multiple-choice questions, and respondents had to choose only one alternative in each question. These questions were mainly based on four aspects: general features, preoperative study, surgical technique, and cementation technique (► **Annex 1**). Surveys not answered in full were excluded.

We located the surgeons using the membership record of the Chilean Committee of Arthroscopic Surgery and Knee Joint Replacement. We sent the survey via cell phone or email using the Google Forms platform. The responses were recorded on the same platform and then transferred to a Microsoft Excel (Microsoft Corp., Redmond, WA, United States) spreadsheet for subgroup analysis and stratification according to years of experience (YOEs), always preserving the anonymity of the participants.

Lastly, we compared the data obtained with those published in national registries from the countries that have said registries, and with those obtained from the survey carried out among SLARD members.

Results

We obtained 87 complete surveys from 192 participants at the time of completion (45% of respondents). ► **Annex 1** shows the individual results of each answer to the multiple-choice questions.

Regarding General Features

Most respondents performed 25 to 50 TKRs per year (44%), with only 16% performing more than 75 cases annually.

Only 20% used the outpatient modality; however, among them, almost half reported doing so with a low frequency (less than 20% of their cases). In total 43% of the respondents believed TKRs must always be performed in a hospital setting. This opinion was more frequent among surgeons with more YOEs (< 10 YOEs: 33%; > 20 YOEs: 62%). Overall, 37% stated that they do not do that because of the lack of appropriate infrastructure.

Most respondents (81.6%) used a posterior cruciate ligament-sacrificing (posterior-stabilized, PS) system. The posterior cruciate-retaining (CR) system was used more often when associated with a robotic system (ROSA [Zimmer Biomet Robotics, Montpelier, France] and CORI [Smith & Nephew, London, United Kingdom]).

The use of robotic systems reached a rate of 18%, with a higher frequency among surgeons with more YOEs (< 10 YOEs: 13%; > 20 YOEs: 35%). The most used systems were the ROSA and CORI (by 85% of surgeons who use robotic systems).

Concerning the Chilean Explicit Health Guarantees (*Garantías Explícitas en Salud*, GES, in Spanish) program, 90% of the respondents believe it must incorporate TKR, with no differences in terms of YOEs.

Regarding the Preoperative Study

Most respondents (56%) performed the radiographic study in the anteroposterior, lateral, axial and Rosenberg views, as well as teleradiography. A total of 14% and 31% of the participants did not report the routine use of teleradiography and the Rosenberg view respectively.

The use of the mechanical axis in preoperative planning was reported by 93%; 69% defined the cutting angle in the distal femur according to the difference between the mechanical and anatomical axes, while 11.5% always used the same angle degrees, regardless of axis differences.

Regarding the Surgical Technique

Regarding the surgical approach, 96.6% used the medial parapatellar approach, and 2.3% (2 surgeons) chose the approach depending on the case.

To determine the rotation of the femoral component, 78% of the surgeons used more than one reference. Most surgeons who used a single reference chose the epicondylar axis (16.3%).

The responses regarding patellar replacement presented a high variation, with no marked trend toward any option; the frequency of the six alternatives ranged from 15% to 27%. In total, 41% of the surgeons tended to replace the patella (in 80% to 100% of their operated cases), while 42.5% tended not to do so (in 0% to 20% of their operated cases). The remaining respondents (16.1%) answered "sometimes" (in 50% of their cases). There were no relevant differences when comparing the responses according to YOEs.

The extramedullary guide was used by 82% to address the tibia, and 80% used the gaps system to check stability in flexion-extension before placing the definitive components, with no differences per YOEs.

Regarding tourniquets, 34.5% of the surgeons did not use them, and 12% turned the device on only during cementation. The remaining surgeons (about 50%) used it during most of the procedures. Among them, most used the device until the components were set (31% of all respondents). There were no differences regarding YOEs.

Most surgeons began implant placement from the tibia (74.8%), while 12.6% started with the femur, and 12.6%, with the patella. The most frequent sequence was tibia-femur-patella (72.4%).

A total of 81% of the surgeons waited until the cementation set before checking the stability of the knee, while 12% did not wait to evaluate it.

Regarding the Cementation Technique

Vacuum systems for cementation were used by 31%, especially those surgeons with fewer YOEs (< 10 YOEs: 36%; > 20



Image 1 Use of vacuum cementation per years of experience.

YOEs: 20%), as shown in ►Image 1. Most surgeons (95.4%) used cement in the components and the bone before its final placement, and the remaining 4.6% placed the cement only in the implant, with no differences in terms of YOEs.

There was a marked trend to place cement on the keel, with only 15% of the respondents not doing so. Most respondents placed the cement with their finger (56.1%) or a spatula (18.3%); only 22% of surgeons used a gun for placement. Most surgeons (95.3%) performed cementation in 1 stage, and only 3.5%, in 2 stages.

Most aspects evaluated presented important differences in the comparison with the national registries from other countries and more similarities with the SLARD registry (especially regarding the surgical technique).

Discussion

The main strength of the present study was the development, as far as we know, of the first record concerning TKR performance in Chile. This procedure is performed with increasing frequency; in Chile, the rate per 100 thousand inhabitants constantly increased in the last decade, going from 6.4 in 2010 to 28.2 in 2019.³ This increase only stopped because of the coronavirus disease 2019 (COVID-19) pandemic, but rates are once again rising at a fast pace. Despite this, we still do not have a Chilean registry to help us objectify and better understand fundamental aspects of surgery and how we are performing TKRs. The presented study achieved a rate of 45% of responses within the target population (the Chilean Committee of Arthroscopic Surgery and Knee Joint Replacement). This may seem like a low number, but it is critical to consider that many Chilean knee specialists do not have much experience with prosthetic surgery. As a result, we expected a high loss when carrying out the survey. This fact explains why it is reasonable to infer that the response rate among surgeons dedicated to prosthetic knee surgery was much higher.

Regarding general features, we found that 67% of surgeons in Chile performed fewer than 50 TKRs per year. This result is consistent with those of registries from countries such as New Zealand and the United Kingdom, but not with the SLARD registry. In New Zealand, 33% of the surgeons

reported performing more than 40 TKRs per year. In the United Kingdom, 34% performed fewer than 25 TKRs per year, and only 12% performed more than 100 TKRs per year. In Latin America, the SLARD study reported that 54% of surgeons performed fewer than 30 TKRs per year, which seems to be a lower number compared with those of our study, since only 24.1% of the participants reported operating fewer than 25 TKRs annually.¹⁰

The present study shows that the number of surgeons performing TKR on an outpatient basis remains low, with only 12% of them doing it frequently. In fact, there still seems to be some apprehension about it, since almost half of the participants believe this option deserves no consideration. The national registries published do not report the percentage of outpatient TKRs, so we cannot make an objective comparison. However, some studies have reported a dramatic increase in outpatient TKR performance, from 0.2% of cases in 2017 to 36.4% in 2019 in the United States.¹¹ In any case, we can infer that the trend in Chile may change over time, since younger surgeons are the ones who consider this option most frequently. In addition, in countries like the United States, Medicare and Medicaid eliminated TKR reimbursement only for hospitalized patients in 2018, and already cover the procedure for patients undergoing outpatient surgery.¹²

The use of robotic systems has increased in Chile in recent years, which can be observed by the rate of 18% of respondents who reported using some technological system. This does not mean that 18% of TKRs are robotic, so we cannot compare it with data from other registries. For instance, the Australian registry showed that 60% of TKRs in 2021 were performed with some kind of assistance, such as navigation, robotic systems, or image-derived instrumentation (IDI), and the American registry⁸ reported 14.7% of imaging-assisted TKRs in 2022 (►Image 2). We can say that Chile has a higher number of surgeons using these systems compared to Latin America per the SLARD registry (5%). We can also state that, in Chile, robotic systems are used more frequently by more experienced surgeons (35% versus 13%), which is probably related to the greater access to these systems in the private sector, which has a higher percentage of surgeons with more than 20 YOEs.

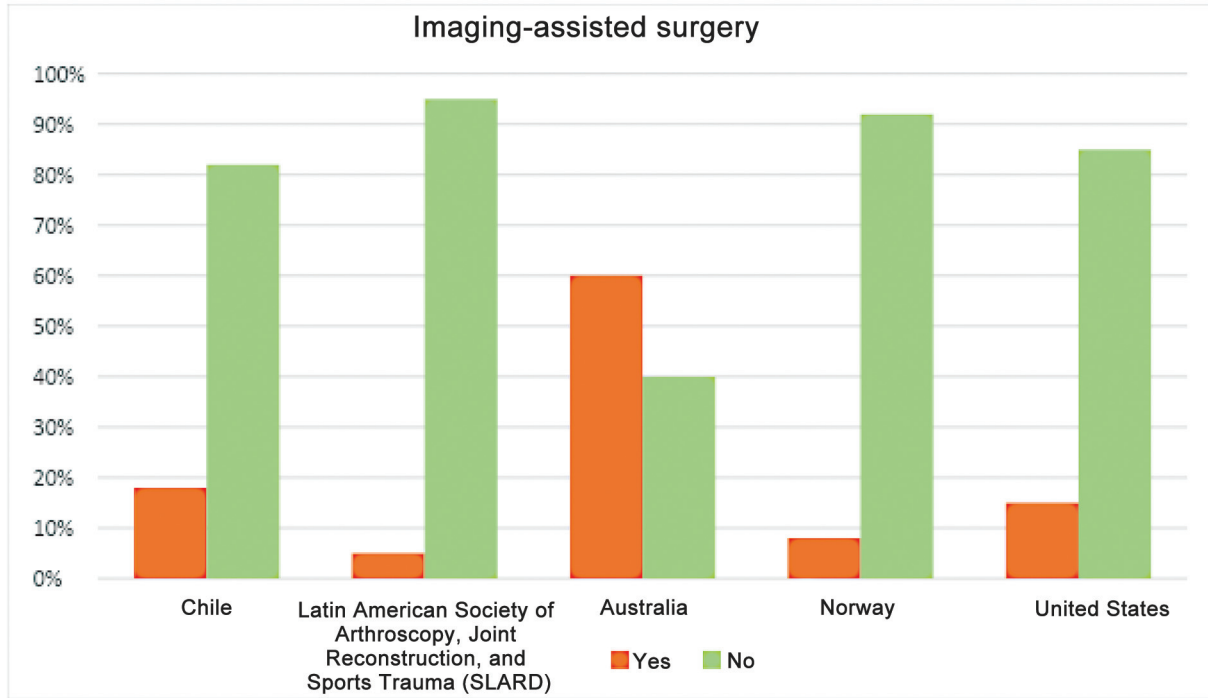


Image 2 Imaging-assisted surgery.

Most Chilean surgeons use the PS system (81.6%) in TKRs, contrasting with Sweden (CR: 96%; PS: 4%), Australia (CR: 76%; PS: 15%; medial pivot: 9%), and New Zealand (CR: 78%; PS: 18%)^{4,5,7} (►Image 3). The Australia and New Zealand registries mentioned using the CR system to a greater

extent due to a slightly lower revision rate compared with that of the PS. In Chile, we do not have published studies comparing the CR and PS systems, only reports of non-comparative cohorts.^{13,14} As a result, the choice still relies on personal experience. Although there was an

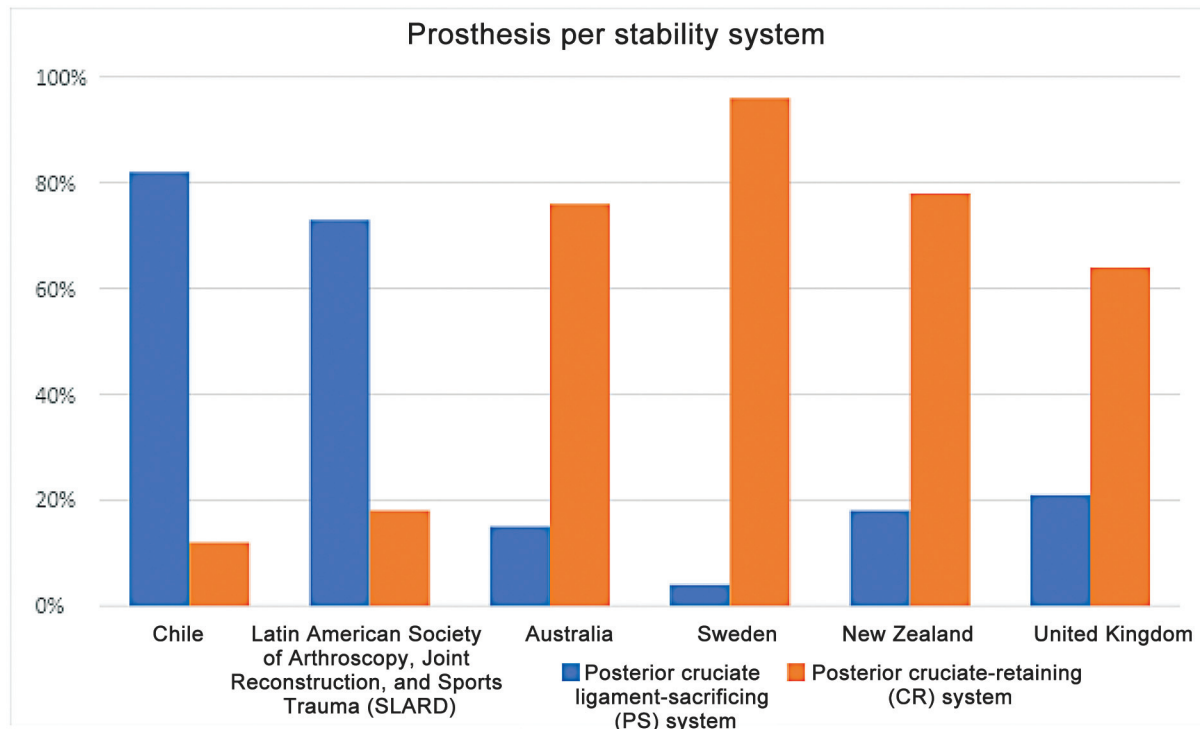


Image 3 Prosthesis per stability system.

association regarding CR component use with the ROSA robotic system, this occurred because one of the groups using a robotic system (per the survey) previously used CR-type prostheses.

Regarding the surgical technique, most surgeons use a medial parapatellar approach (96.6%), which is consistent with international registries.

The decision to perform patellar replacement has always been controversial, with countries like the United States and Australia showing high replacement rates, ranging from 92% to 94% and 76% respectively. However, other countries record very low rates, including New Zealand (35%), Norway (7%), and Sweden (4%). The present study showed that 41% of the surgeons tend to replace the patella in most cases, which is more in line with the data from the SLARD study (approximately 50%).¹⁰ The decision remains surgeon-dependent, based on local experience, as demonstrated by the Australian registry, which showed a slightly higher revision rate in patients operated on without patellar replacement, which motivated their surgeons to change their conduct around 2010.⁴

Regarding tourniquets, approximately 65% of the respondents used them at some point during surgery. This trend was consistent with the SLARD study and it was also very similar to the Norwegian registry, which reported a 61% usage rate in 2020. However, worldwide, the records are very variable; for instance, in the United States,⁶ a study reported a 100% usage rate in 2010,¹⁵ while Sweden recorded a 28% rate in 2021.⁷

Finally, regarding the cementation technique, we observed that only 31% of the surgeons use vacuum systems; however, this frequency is higher among younger surgeons. Although there are not many publications about this issue, a survey answered in 2022 by 903 knee surgeons in the United States showed that 80% used vacuum systems during TKR.¹⁶ The literature is somewhat contradictory regarding the benefit of using vacuum systems, since some studies showed more cement penetration into the bone,¹⁷ while others did not observe many differences.¹⁸ As such, we still do not have clear guidelines regarding which technique to use, which is why the use of vacuum systems is not yet popular in many countries (including Chile).

Conclusion

There is high variability in the performance of knee arthroplasties in Chile, with some trends similar and others very different from registries from other countries and greater consistency with the Latin American SLARD registry. In general terms, regarding different YOE, there are no major differences in the surgical technique, although there are differences in the cementation technique and use of robotic systems.

Note

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Conflict of Interests

The authors have no conflict of interests to declare.

References

- Kurtz S, Ong K, Lau E, Mowat F, Halpern M. Projections of primary and revision hip and knee arthroplasty in the United States from 2005 to 2030. *J Bone Joint Surg Am* 2007;89(04):780–785. Doi: 10.2106/JBJS.F.00222
- Baker PN, Rushton S, Jameson SS, Reed M, Gregg P, Deehan DJ. Patient satisfaction with total knee replacement cannot be predicted from pre-operative variables alone: A cohort study from the National Joint Registry for England and Wales. *Bone Joint J* 2013;95-B(10):1359–1365. Doi: 10.1302/0301-620X.95B10.32281
- Barahona M, Martínez Á, Barahona M, Ramírez M, Barrientos C, Infante C. Impact of COVID-19 outbreak in knee arthroplasty in Chile: a cross-sectional, national registry-based analysis. *Medwave* 2022;22(04):e8731. Spanish, English Doi: 10.5867/medwave.2022.04.002511. PMID: 35580323
- Australian Orthopaedic Association National Joint Replacement Registry. Annual Report. Adelaide, Australia: AOA <https://aoanjr.sahmri.com/annual-reports-2022>
- The New Zealand Joint Registry. Annual Report. <https://www.nzoa.org.nz/annual-reports>
- Norwegian Arthroplasty Register. Annual report of The Norwegian Arthroplasty Register, The Hip Fracture Register, Knee Ligament Register and Pediatric Hip Register of Norway. DOI:10.13140/RG.2.2.34266.26566
- Swedish Knee Arthroplasty Register. https://registercentrum.blob.core.windows.net/sar/r/SAR-Annual-Report-2022_EN-HkgQE89Nus.pdf
- American Joint Replacement Registry Available at: http://www.ajrr.net/images/annual_reports/AJRR-2017-Annual-Report-Final.pdf?hsCtaTracking=61a2fedc-0f48-4241-a282-2bca6e4b68ad%7Ce4ed88d8-6b8e-4d0c-9a47-d1c169759e83
- National Joint Registry for England, Wales, Northern Ireland and the Isle of Man. <https://reports.njrcentre.org.uk/Portals/0/PDFdownloads/NJR%2019th%20Annual%20Report%202022.pdf>
- Figueroa D, Figueroa F, Calvo R, Vaisman A, Figueroa M, Putnis S. Trends in Total Knee Arthroplasty in a Developing Region: A Survey of Latin American Orthopaedic Surgeons. *J Am Acad Orthop Surg* 2020;28(05):189–193. Doi: 10.5435/JAAOS-D-19-00260
- Barnes CL, Iorio R, Zhang X, Haas DA. An examination of the adoption of outpatient total knee arthroplasty since 2018. *J Arthroplasty* 2020;35(6S):S24–S27. Doi: 10.1016/j.arth.2020.01.073
- Centers for Medicare & Medicaid Services. Total knee arthroplasty (TKA) removal from the Medicare Inpatient-Only (IPO) list and application of the 2-Midnight Rule. Available at: <https://www.cms.gov/Outreach-and-Education/Medicare-Learning-Network-MLN/MLNMattersArticles/Downloads/SE19002.pdf>. Accessed February 5, 2020
- Numair J. Total knee arthroplasty with preservation of the posterior cruciate ligament: results after 7 years of follow-up. Total knee arthroplasty with preservation of the posterior cruciate ligament: results after 7 years of follow-up. *Rev Chill Orthop Traumatol* 1998;39(02):32–43
- Paulos J, Wagner E, Lisoni A. Total knee arthroplasty with posterior stabilized prosthesis: 10 years experience. Total knee arthroplasty with posterior stabilized prosthesis: 10 years experience. *Rev Chill Orthop Traumatol* 2001;42(01):29–36
- Berry DJ, Bozic KJ. Current practice patterns in primary hip and knee arthroplasty among members of the American Association of Hip and Knee Surgeons. *J Arthroplasty* 2010;25(6, Suppl)2–4. Doi: 10.1016/j.arth.2010.04.033

- 16 Martin JR, Archibeck MJ, Gililand JM, et al. Trends in Total Knee Arthroplasty Cementing Technique Among Arthroplasty Surgeons-A Survey of the American Association of Hip and Knee Surgeons Members. *J Arthroplasty* 2022;•••: Epub ahead of print. Doi: 10.1016/j.arth.2022.12.034
- 17 Lutz MJ, Pincus PF, Whitehouse SL, Halliday BR. The effect of cement gun and cement syringe use on the tibial cement mantle in total knee arthroplasty. *J Arthroplasty* 2009;24(03):461–467. Doi: 10.1016/j.arth.2007.10.028
- 18 Kopec M, Milbrandt JC, Duellman T, Mangan D, Allan DG. Effect of hand packing versus cement gun pressurization on cement mantle in total knee arthroplasty. *Can J Surg* 2009;52(06): 490–494