Original Article

Lumbar intervertebral disc replacement in Australia: An epidemiological study

ABSTRACT

Introduction: Favorable short- and long-term outcomes have been reported for lumbar intervertebral total disc replacement (L-TDR). However, there is little evidence regarding the uptake of L-TDR in practice. The objective of this study was to analyze Australian-based population trends in L-TDR over the past 5 years.

Methods: The 5-year incidence of L-TDR from 2019 to 2023 in adult patients was analyzed using the Medicare Benefits Schedule (MBS) database. Data were stratified by sex and year, with an offset term introduced using population data from the Australian Bureau of Statistics to account for population changes over the study period.

Results: A total of 1558 L-TDRs were completed in Australia under the MBS in the 5 years of interest. The 5-year annual mean case volume was 311.6 cases per annum. A downtrend and plateau in the rate of L-TDR has been seen from 2021 onward. The distribution of L-TDR across ages showed a significantly higher concentration in the 35–44 and 45–54 age groups ($P < 0.05$). More operations were performed in males ($n = 876$, 56.2%) than females ($n = 682$, 43.8%).

Conclusions: The uptake of L-TDR has declined throughout the 5-year study period in Australia. Despite modest use currently, the future of L-TDR will rely on more robust long-term outcome data.

Keywords: Degenerative disc disease, intervertebral disc replacement, lower back pain, lumbar spine

INTRODUCTION

Lower back pain (LBP) is the leading cause of productivity loss worldwide,[1] and is strongly associated with degenerative disc disease (DDD).[2,3] Lumbar DDD presents challenges in management due to limited regenerative capacity,[4] variable response to nonoperative measures,[5] complex psychosocial contributory factors,[6] and arduous long-term interdisciplinary follow-up.[7] Surgical intervention may be indicated in the setting of progressive neurological findings, or when nonoperative measures fail. Lumbar fusion (LF) has demonstrated comparable outcomes to nonoperative measures for the treatment of chronic LBP in randomized studies, with associated complication rates of up to 15%.[8-11]

Over the last decade, lumbar intervertebral total disc replacement (L-TDR) has demonstrated favorable patient satisfaction and clinical outcomes,[12,13] with diminished

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operative time, hospital stay, and complication rates compared to LF.[14] However, a national database study in the United States noted that rates of lumbar disc arthroplasty decreased by 82% between 2005 and 2017,[15] which may be due to early outcomes indicating an equivalent complication and revision profile to fusion.[16,17] There is a paucity of other population-level data on incidence and trends regarding L-TDR, which is essential information that guides resource utilization, policy, and budgets.

Thus, the objective of the present epidemiological study is to analyze the trends in the uptake and utilization of L-TDR in Australia.

METHODS

Data from the Australian Government Department of Health Medicare Benefits Schedule (MBS) registry were utilized for this epidemiological study. The MBS is a publicly funded health insurance scheme that maintains a comprehensive itemized list of procedures for which eligible patients receive subsidies to cover medical costs. Since data retrieved from MBS are publicly available and does not involve the direct participation of individuals, ethics approval was deemed unnecessary.[18-22]

As of June 2024, the number of services claimed per calendar year over the 5-year period between 2019 and 2023 was identified by querying item number 51130, which represents "lumbar artificial L-TDR at one motion segment." Information was gathered for patients aged 15 years and older. Data were organized by sex, age, and calendar year, with per capita data expressed as rates of service per 100,000 population. Patient demographics were stratified by 10-year age groups according to those collected in the MBS registry. The determination of distribution was via the Shapiro–Wilk test. Comparison of nominal and interval variables was performed through the implementation of the Kruskal–Wallis test. With alpha set at 0.05, longitudinal service utilization patterns were correlated and quantified using Spearman's rho (rs). Least squares analysis was used to identify the coefficient of linear regression.[23] Statistical analysis was conducted via SPSS Statistics for Macintosh, Version 28.0. (Armonk, NY, USA: IBM Corp).

RESULTS

A total of 1558 L-TDRs were completed in Australia under the MBS in the 5-year period of interest [Table 1]. The 5-year annual mean case volume from 2019 to 2023 was 311.6 cases per annum. The increase in the annual volume of cases over this 5-year period was statistically insignificant [rs = 0.09, P = 0.44, Figure 1]. Similarly, population-adjusted data over the 5-year period of interest revealed an insignificant increase in the per capita incidence of L-TDR [rs = 0.31, P = 0.28, Figure 2].

More operations were performed in males [n = 876, 56.2%, Figure 1 and Table 1] than in females [n = 682, 43.8%, Figure 1 and Table 1] during the study period. The distribution of L-TDR across age groups varied, with a significantly higher concentration in the 35–44 and 45–54 age groups [H (7) =32.45, $P < 0.05$, Figure 3]. This trend was consistent regardless of sex, with L-TDR performed at a significantly higher rate in the 35–54 age range for males [H (7) =33.49, $P < 0.05$, Figure 4], and significantly higher in the 35–54 age range in females [H (7) =31.31, $P < 0.05$, Figure 4]. This age group predilection was maintained when analyzed per capita for both sexes (H (7) =53.41, $P < 0.05$).

DISCUSSION

This nationwide epidemiological study demonstrates that utilization of L-TDR per capita peaked in Australia during

Table 1: Distribution of total disc replacement cases by sex and age group

Demographic	*n* (%)
Number of cases	1558
Sex	
Male	876 (56.2)
Female	682 (43.8)
Age group	
15–24	43 (2.8)
25–34	184 (11.8)
35–44	496 (31.8)
45–54	419 (26.9)
55–64	250 (16)
65–74	136 (8.7)
75–84	30 (1.9)
>85	0

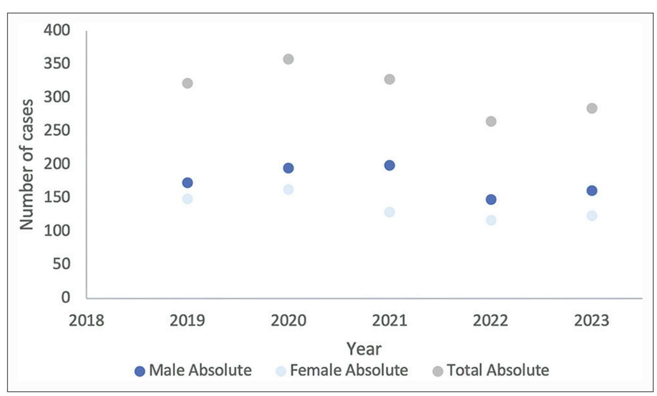

Figure 1: Total number of total disc replacements performed per year by sex

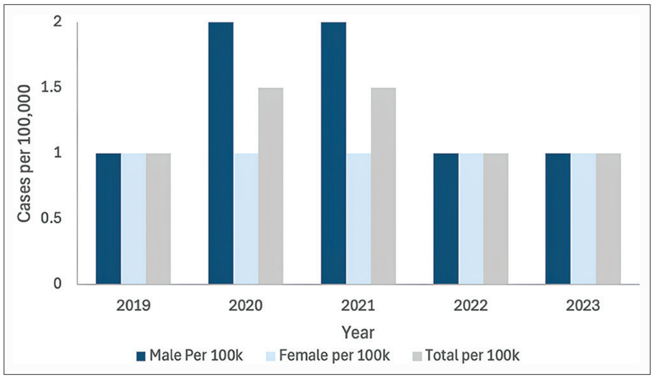

Figure 2: Number of total disc replacements performed per capita number of cases per 100,000 per year, by sex

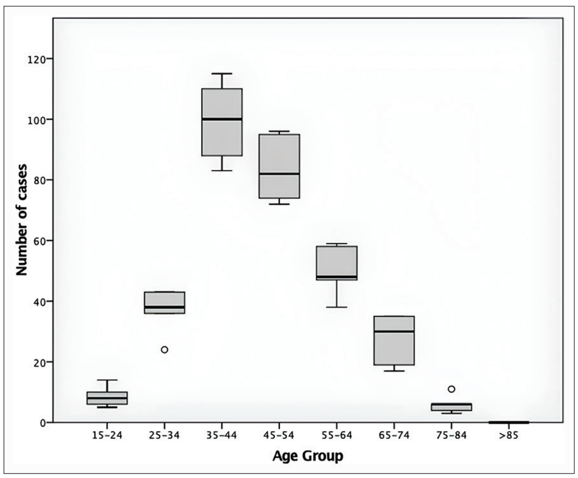

Figure 3: Median number of total disc replacements per age group, per annum from 2019 to 2023

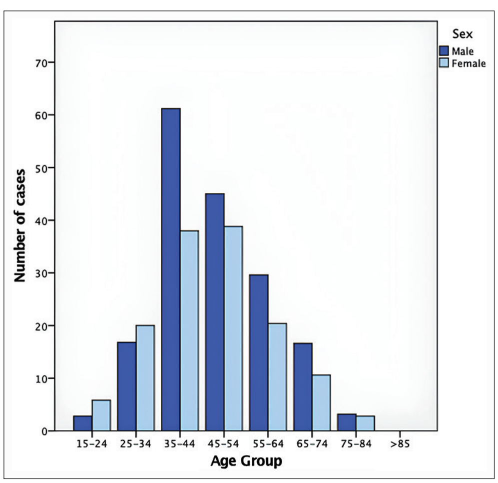

Figure 4: Age distribution of total disc replacements performed in Australia from 2019 to 2023, by sex

2020, with a decline noted to the current plateau [refer to Figure 1]. The adoption of L-TDR has been modest worldwide, especially when compared to alternative treatment modalities. Upfill-Brown used the National inpatient sample to perform a national database study comparing L-TDR to LF in the United States for the decade between 2010 and 2019.[24] The rate of L-TDR was dwarfed by LF, comprising 0.7% (n = 8049) and 99.3% (n = 1,129,121) of procedures conducted during the period, respectively.[24] Interestingly, propensity-matched single-level L-TDR patients demonstrated diminished healthcare costs (by USD 4528) and shorter in-hospital stays (by 0.65 days) when compared to patients undergoing single-level LF.[24] Significantly lower total complication rates (7.0% vs. 13.2%, $P < 0.001$) and rate of blood transfusion (3.1% vs. 8.1%, $P < 0.001$) in matched patients were also noted.[24] Mills also performed a national database study in the United States, finding that utilization of L-TDR had decreased by 82% between 2005 and 2017.[15] Similar findings were noted in a Scandinavian registry study (conducted across Denmark, Norway, and Sweden) by Andersen, who found that of patients who underwent surgery for lumbar DDD between 2011 and 2013, 21% (n = 395, $P < 0.001$) underwent L-TDR as opposed to 79% (n = 1444, $P < 0.001$) who received LF.[25]

Global underutilization of L-TDR has been noted despite multiple recent encouraging retrospective studies, randomized controlled trials, and meta-analyses favoring L-TDR over LF across many metrics[12,26-32] even up to a follow-up period of 10 years.[13] This may be due to an array of factors, including a paucity of long-term results for an operation largely performed on a younger cohort [refer to Figure 3], stringent eligibility criteria, early papers citing equivalent outcomes to fusion, concerns regarding revision burden,[16,17,33] surgical complexity, limited available replacement devices, and surgical conservatism.[34,35] Further long-term data, such as complications, implant durability, and patient outcomes up to 20 years postoperative are likely to determine future trends in L-TDR use.[24,34] This long-term data is especially important given that the current study finds that implantation of L-TDR in Australia is focused on those aged between 35 and 54.

The decline in L-TDR utilization in Australia during 2021 is likely a result of the COVID-19 pandemic. Overall rates of elective surgery in Australia fell 17% between 2020 and 2022, to the lowest levels since 2010, as an emphasis on optimization of resources for essential surgeries became tantamount.[36] Following the World Health Organization's declaration of a pandemic in March 2020, Australia implemented public health measures that restricted travel, public gatherings, sports, and work-related activities. Al-Omran deduced that Australia experienced a 20% reduction in orthopedic trauma admissions during the pandemic,[37] reaching up to a 31% reduction in Sydney.[38] When considering spinal operations, Probert reported 7.3% fewer interventions during the pandemic.[39] It would be reasonable to expect that procedures such as L-TDR would have seen an increase since 2022, with the recommencement of all elective surgeries and focus on clearing backlogged waitlists in Australia. Instead, the rates have plateaued at the same level as during the pandemic despite encouraging evidence in favor of its use. In comparison, a meta-analysis by Papalia found that the incidence and intensity of LBP increased globally during the pandemic (8 studies, $n = 2365$).[40]

This study should be interpreted with consideration of several limitations. MBS data include operations performed on private patients within both public and private systems, omitting procedures on public patients funded by state government block grants and those under alternative insurance schemes.[18] However, there has been a stable proportion of private health insurance adoption over this 20-year period (approximately 45%), and therefore, the trends seen may be extrapolated to the Australian population.[41] Further, data obtained from the MBS code "51130" only include single-level L-TDR, thereby affecting comparison with countries that include multiple-level L-TDR. Work cover and Third-Party surgeries are not captured by MBS data and are thus not reflected in the current study.

CONCLUSIONS

The present epidemiological study demonstrates trends in L-TDR utilization and forms a basis for future comparison. The use of L-TDR in Australia has decreased during the COVID-19 pandemic and subsequently plateaued despite evidence supporting L-TDR over LF in metrics of cost, hospital length of stay, and complication rates. Further analysis to determine the reasons for this trend would be useful. The future of L-TDR relies on stronger, longer-term outcome data.

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Conflicts of interest

There are no conflicts of interest.

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