



Failure of lumbar disc surgery: management by fusion or arthroplasty?

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Abstract

Purpose To analyze and clarify conflicting aspects of fusion and total disc replacement (TDR) surgery in literature.

Method Using keywords, 23 literature reviews, 41 studies accepted by “importance criteria” from the Internet, and 16 articles “published in 2018” were chosen. Altogether 80 studies.

Results *General assessment* was mentioned as affirmative for TDR in 40 papers, five were negative, 24 without clear decision. *Long term results* TDR seven affirmative, four nondecisive. *Comparison to fusion* (general, ALIF, 360⁰, BAK cage) 18 found as better, nine equal, one nondecisive. *Complications* TDR 3–50%. *Adjacent disc degeneration disease* recognized in 14 papers, denied existence in four. *Cost-benefit effective* in three papers comparing to fusions, ALIF, 360⁰. *Nonimbursement* from the state mentioned as problem in three papers. *Salvage surgery* seven papers, rare but extremely problematic. *Anterior approach* 16 challenging surgery, one 10% minor, one 38.5% transient complications, one 1.8% retrograde ejaculations, one 6.6% vascular injuries, two access surgeon needed. *Construct judgment* two no importance, 22 wear and durability problems, two inadequate biomechanics and biomaterials, three construct and lateral approach. *Impact of TDR upon spine surgery* is decreasing, currently is less than 2%.

Conclusion It is concluded that problems with anterior surgery, imbursement policy, and potential problems with salvage surgery are major reasons for loosing popularity of TDR surgery.

Keywords Failed disc surgery · Arthroplasty · Fusions · Literature review

Introduction

Surgical discectomies due to nerve root compression are frequent procedures (more than 20,000 per year in USA) [1]. However, Parker's systematic review demonstrated a range of recurrent back or leg pain in 5–36% of patients after two years [2]. Conservative treatment for failed discectomy is of problematic success. Fritzell compared it to surgery and introduced in 2001 lumbar fusion as a golden standard for chronic back pain [3]. A Swedish lumbar study group reported spine fusion to be more expensive than conservative treatment, but it is more cost-effective [4]. However, they found out that three surgical techniques (posterior, instrumented, anterior) brought the equal clinical results [5]. It raised a question about quality of indications for spinal fusion. Lee [6] did not

find a correlation between solid radiological fusions and clinical pain elimination. There is a much higher rate of successful lumbar fusions than excellent pain relief. Recognizing the problem of adjacent disc disease (ADDiS) and problematic fusion results, interest for total disc arthroplasty (TDR) was raised.

Charité model, developed in early 1980s in Berlin, became popular, and new models of TDRs appeared on the market. After widespread use of TDR, conflicting reports appeared. Currently, there is a 170.9 % increase of fusions and 11.3% of laminectomies in ten years in USA [1]. On the other hand, despite mainly favourable assessments, number of TDR surgeries is decreasing (Charité disc received FDA approval in 2004 and is withdrawn from the market in 2012). The question is: is it an outdated surgery or not [7, 8]? Currently, there are approx. 406,000 results on Google search for TDR question (the results vary significantly on repeated questions). Despite such extensive statistics and studies, we still do not have a clear standpoint about the procedure.

Purpose The purpose of the study is to clarify conflicting standpoints of fusion and TDR in failed disc surgery.

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Materials and methods

An enormous number of studies were found on the Internet. Solutions “sorted by importance” and “sorted by published time range” were offered. Keywords “Academic articles for lumbar disc arthroplasty review” were put on Google. Twenty-seven thousand two hundred results were found. The first eighty results were taken. After excluding nonrelevant papers, there were 23 reviews and 41 studies available. From criteria “sorted by time range” (225 results), first 16 articles published in 2018 were selected. At last, altogether there were 80 studies. Points of interest that can clarify the role of TDR and fusion in chronic backache were taken out and analyzed (Table 1).

Results

There were 11 relevant points of interests recognized. The number of articles and judgements are presented as follows:

Legend: positive (+), negative (−), no decision (±), equal (=), unsure (?)

General judgment: 40(+), 5(−), 24(±); *Long term results:* 7(+), 1(±), 3(?); *Comparison to fusion:* 12(+), 8 (=), 1(±), to ALIF 3(+), 1(=), to BAK cage 2(+), to 360⁰ 2(+); *Complications TDR:* 23(3–50%); *ADDdis recognized as problem:* 14(+), 4(−); *Cost benefit:* 3(+) (to general, 360⁰, ALIF); *Imbursement policy:* 3(−); *Salvage surgery:* seven (rare but problematic, one leg amputation); *Anterior approach:* 16 Challenging surgery one (10% minor complications), one (38.5% short-term complications), two (access surgeon needed to reduce complications), one (6.6% vascular complications, one (1.8% retrograde ejaculation); *Construct judgment:* two (no importance), 22 implant durability (?), wear problems of polyethilen and metal (?-), one inadequate biomechanics, one new biomaterials needed, three construct for lateral approach needed; *Impact upon spine surgery:* 4(−)

Discussion

Failed disc surgery is a well-recognized condition, but despite the enormous amounts of studies, we still do not have a clear standpoint towards the problem. Only for TDR, there are 406,000 results found on Google search. Although TDR has been in use from early 1980s, majority of reviews demand longer follow-up and higher study qualities. However, the number of TDR surgery is decreasing [8, 15, 40, 60]. There is a TDR surgery decrease of 86% between 2005 and 2013 [15]. Waiting for further studies will probably result in TDR

Table 1 Selected articles

| | Reviews | Studies | Published 2018 |
|-----|--------------------|-----------------|------------------|
| 1. | Formica [7] | Putzier [9] | Shultz [10] |
| 2. | Saltzman [8] | Tropiano [11] | Plais [12] |
| 3. | Jacobs [13] | Mayer [14] | Saifi [15] |
| 4. | Abi-Hanna [16] | Sasso [17] | Mayer [18] |
| 5. | De Kleuver [19] | van Ooij [20] | Stubig [21] |
| 6. | Van Eerenbeem [22] | Cunningham [23] | Scott-Young [24] |
| 7. | Anderson [25] | Farfan [26] | Furunes [27] |
| 8. | Freeman [28] | Delamarter [29] | Hur [30] |
| 9. | Nie [31] | Bertagnoli [32] | Lazennec [33] |
| 10. | Hoffman [34] | Deyo [35] | Gelalis [36] |
| 11. | Zigler [37] | Bertagnoli [38] | Faure [39] |
| 12. | Lee [6] | Park [40] | Wuertinger [41] |
| 13. | Saavedra [42] | Resnick [43] | Grassner [44] |
| 14. | Xia [45] | Punt [46] | Park [47] |
| 15. | Gibson [48] | Kapural [49] | D Este [50] |
| 16. | German [51] | Schulte [52] | Lu [53] |
| 17. | Büttner-Janz [54] | Berg [55] | |
| 18. | Stieber [56] | Siepe [57] | |
| 19. | Patel [58] | Mayer [59] | |
| 20. | Awe [60] | Mobbs [61] | |
| 21. | Schlussmann [62] | Goel [63] | |
| 22. | Reeks [64] | Gan [65] | |
| 23. | Harrop [66] | Guyur [67] | |
| 24. | | Kurtz [68] | |
| 25. | | Rajaraman [69] | |
| 26. | | Assell [70] | |
| 27. | | Hellum [71] | |
| 28. | | Zigler [72] | |
| 29. | | Geissler [73] | |
| 30. | | McAfee [74] | |
| 31. | | Blumental [75] | |
| 32. | | Wong [76] | |
| 33. | | Fritzell [77] | |
| 34. | | Hägg [78] | |
| 35. | | Mattei [79] | |
| 36. | | Bertagnoli [80] | |
| 37. | | Siepe [81] | |
| 38. | | Bao [82] | |
| 39. | | Siepe [83] | |
| 40. | | Bertagnoli [84] | |
| 41. | | Bertagnoli [85] | |

disappearing from the market. It is surprising that Charité implant received Food and Drug Administration (FDA) approval in 2004, and in 2012 was withdrawn from the market. It is evident that there is an increase in laminectomies, posterior fusion procedures, and cervical TDRs. Anterior lumbar interbody fusion (ALIF) is stagnating [60] while TDR is

decreasing. It seems from the literature that TDR has an affirmative general assessment (40+, 5–, 24±). Some of the respectable sources, Swiss National Registry [62], Cochrane review, [13], and FDA studies, [72, 74, 75] conclude that TDR is at least not inferior to fusion. TDR is more cost-effective [15, 21, 77]; patient recovery is quicker. Two great TDR advancements are potential ADDis prevention and better sagittal balance due to trunk self-repositioning [7, 12, 39–42]. Primary hybrid constructs in polysegmental disease or TDR treatment in the ADDis problems postfusion seem to be reasonable [24, 32, 63, 85]. The main question therefore is, why the TDR is rejected by orthopaedic surgeons? It seems that avoidance of anterior approach in lumbar region might be one of the major reasons. There is a significant inherent risk of major complications related to lumbar anterior approach [32, 40, 61, 69]. It is notable that TDR in cervical region and posterior fusions are increasing, while ALIF is stagnating and TDR decreasing. Anterior revisions and salvage TDR surgery is for sure a major reason for rejecting the procedure. TDR revision is a life threatening condition, demanding staged team approach [8, 20, 34, 40, 49, 56, 58, 60], with described catastrophic consequences (leg amputation) [71]. Imbursement policy is by all means an obstacle in choosing the TDR in practice. Biomechanical considerations might be of importance. Increased torsional stress is described as deleterious for spinal joints by Farfan [26]. Anterior longitudinal ligament resection in combination with nonconstrained implant might induce an increased stress to facet joints. (Antero) lateral approach [40, 86] and viscoelastic implants might be a solution for better results. However, new techniques will eliminate current problems, but will bring new complications, like lumbosacral plexus exposure to injury, or dislocations of the viscoelastic TDR core [44]. Despite problems, it does not seem reasonable to withdraw back to well-known fusion procedures. Transpedicular instrumentation still needs to diminish procedure complications [87, 88]. The rate of successful fusions is greater than 90%, and here is nothing further to be done. The fact that successful fusion does not match to clinical outcome, the fact that all the fusion techniques result in similar clinical outcome, does not encourage as well. There is approx. 58% of inaccurate diagnostics in spine surgery [89], and surgical revision is successful in only 35% of failed back spine surgery (FBSS) [90]. It raises the need for carefully choosing type of surgery [91], and for searching for other less aggressive modalities of treatment [92]. By all means it is necessary to avoid overtreatment and overestimation of the problem [93]. We need to improve our anterior surgery competence, to improve our x-ray pre-operative study [94, 95]. Better understanding and detecting the spinal pain generators is necessary. TDR needs improvements, but it is definitely the method that should stay, especially in failed disc surgery, where facet joints may be in very good condition.

Conclusion

TDR is a device potentially superior to fusion. However, anterior approach, revision surgery, imbursement policy, and some biomechanical considerations might be obstacles. Increasing posterior fusions and cervical TDRs, stagnating ALIF, and decreasing TDRs are indicative. Better understanding and detecting the spine pain generators is necessary to improve our indications for both fusions and TDRs. TDR is definitively a method to stay, and failed disc surgery seems to be an excellent indication for TDR.

Compliance with ethical standards

Conflict of interest The author declares that he has no conflict of interest.

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