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Archaic and historicalsurgicaltechniques in neurosurgery:lumbarspinesurgery

Zygmunt Siedlecki[1], Karol Nowak[1],Adam Wróblewski[2], Sebastian Grzyb[3], and Maciej Śniegocki[1]

[1]Department of Neurosurgery, Neurotraumatology and PediatricNeurosurgery, The Ludwik Rydygier Collegium Medicum in Bydgoszcz, The Nicolaus Copernicus University in Toruń

[2]Department of Ancient and ByzantineHistory, Institute of History and Archives, Faculty of Historical Sciences, Nicolaus Copernicus University in Toruń

[3]Department of ClinicalPharmacology, The Ludwik Rydygier Collegium Medicum in Bydgoszcz, The Nicolaus Copernicus University in Toruń

Correspondingaddress:
Dr. med. Zygmunt Siedlecki Department of Neurosurgery, Neurotraumatology and PediatricNeurosurgery,
the Ludwik Rydygier Collegium Medicum in Bydgoszcz,
ul. Skłodowskiej-Curie 9
85-094 Bydgoszcz
tel.: + 48 606 302680
e-mail: siedlecki@cm.umk.pl

Abstract

Neurosurgery improves treatment methods and surgical techniques. The development of medical equipment,tools and techniques of surgery leads to better treatment effects and reduces its invasiveness. This shortens the treatment process, makes it better for patients, and enables faster and more effective rehabilitation.Thus, it improves the results of treatment.Lumbar spine diseases (discopathy, stenosis, injuries, cancers) are very common in the society, and their treatment has been a part of neurosurgery since the 1930s. We argue that lumbar discopathy / stenosis surgery is the most common procedure performed by neurosurgeons. This prompted us to review and look at the history of these procedures.We discuss the surgical techniques of lumbar spine surgery, which were used previously, while in modern times, due to the development of medicine, the development of implants and equipment, they are of historical importance or are very rarely used. We remind in this manuscriptlumbar discectomy performed by wide laminectomy. We also remind of the archaic spine fusion techniquesusing loops orown bone. We emphasize that by the use a microscope and modern implants, as well as scientific reports about surgical techniquesimprovement, nowadays such operations are performed less invasively and for the benefit of patients.

Keywords:lumbarspinesurgery, neurosurgery,historicaltechniques

Introduction

Lumbar spine -neurosurgical proceduresare commonly performed by all neurosurgeons around the world.Contemporarythesesurgicaltechniquesare focused on minimallyinvasivesurgery (MIS). Its idea is to minimizetissueinjury,

cut the length of the skin and shorten the time of the procedurę [1]. Eachsurgicalprocedureisstressful, triggersaninflammatorycascade and oxidativestress. Therefore, the aimis to reducethis to a minimum.MIS isespeciallyimportantbecausepatients want to quicklyregainprofessionalactivity [1], do not want to stay in the hospital and want to functionnormally as soon as possible [2]. Moreover, MIS isimportant in the case of commercialspinesurgeries (more and moreoftenperformed), where the duration of the procedure and hospitalstaymust be as short as possible for economicreasons.Commercial surgeries are performed in economically developed countries and where the private insurance system allows it. Nowadays, a significant part of lumbar procedures is performed in the commercial sector [2].
Currently, in the year of publication of thismanuscript (2021), from the author's point of view (ZS), differneces insurgicaltechniquesover the last 20 yearsarenoticeable, and based on the literature, medicaldocumentation and senior neurosurgeons-colleaguesreports,essentialdifferencebetwe en the currentsurgeries and those from the second half of the twentiethcenturyisnoted.

The differences in operation techniques used in the past, in the 20th century, compared to modern surgery are due to several reasons:

1. Spineimplants, whicharenowwidelyused to supportspinesurgerytechniques, but whichwere not therebefore andownbonegraftswereused.

2. Microscopy and endoscopy, whichareusedtoday, but previously not available, and extensivesurgicalapproacheswereperforme d in order to visualize the operatedanatomicalstructures

3. X-rayfluoroscopy, whichenables the preciselocalization of the operatedlevel, previouslysuchfluoroscopy was less available, whichalsorequiredextensiveapproach to be made to palpate the level.

In addition, the development of science, surgical techniques and studies on the pathophysiology of back pain made it possible to introduce completely new medical procedures, previously unknown. Examples of such procedures are cryoablation, thermolesion and nucleoplasty. In justified cases, these procedures can replace the more extensive ones, or provide an opportunity to treat diseases that have not been treated neurosurgically in history [3].

Spinesurgerydeals with the surgicaltreatment of threebasicgroups of diseases

1. degenerative disease of the spine

2. spine injuries

3. spinetumors (neoplastic diseases)

In each of the above-mentioned groups, surgical treatment consists in decompressing the nerve structures and stabilizing the spine. In tumors, decompression is the excision of the tumor mass.Degenerative diseases include disc hernia, degenerative stenosis, and spondylolisthesis (degenerative and true with spondylolysis).Injuries are fractures and dislocations of the spine that cause instability and pressure on nerve structures.The firstexplorations of the

spinal canal wereperformed in the late 19th and early 20th centuries by MacEwen, Horsley, Krause, Taylor, Dandy, and Cushing, amongothers [4].Surgery for a spinal canal tumor by Horsleyisessentiallyconsidered to be the firstneurosurgicalprocedureperformed by laminectomy [5].The history of surgical treatment of lumbar discopathy dates back less than 100 years since the publication of this manuscript. The first lumbar discectomy operation was performed by Mixter and Barr in 1932 [6]. Initially, the creators of this procedure preferred transdural access. In the following years, in 1938, Love described epidural access, providing the basis for the surgical technique that is still used today [7]. His technique, although modified with improved illumination, magnification, and retractors, remains the primary approach to disc hernias today. Initially, lumbar discopathy procedures were performed without a microscope, with the naked eye. This forced extensive skin cuts and tissue accesses to be made.The firstpublicationsdocumenting the microsurgicaldiscectomyprocedureappeared in 1977 [7,8]. Backthen, bothYassargil, whoworks in Switzerland, and Caspar, whoworks in Germany, reported on theirexperience of usinganoperatingmicroscope in lumbardiscopathysurgery. In 1978 Wiliams, whosegroup of describedpatientsincluded Las Vegas dancers, popularized the microdiscectomytechnique in the United States [9]. The authorshowed in a series of 532 patientsthatsurgicalscarscan be minimized and thatpatientscan return to workfaster by using a technique to removeonly part of the damaged disc to decompress the affectednerveroot. The report by Williams et al. (1978) prompted a discussionamongneurosurgeonsexperienced in lumbardiscopathy as to whichmicrosurgicaltechniquewouldprovide the bestresults, preventingrecurrence and the need for reoperation [9].Caspar et al. (1991), Wilson and Harbaugh (1981), and otherauthorsbelievedthatmoreextensive disc removal was necessary to preventrecurrence and providebetternerverootdecompression [10,11]. Therefore, theseauthors, despite the introducedpossibility to minimize the scope of lumbardiscopathysurgery, preferredmoreextensiveaccesses and open surgicaltechniques. In Poland, in manyneurosurgicalcenters, surgery of lumbardiscopathy with moreextensivetechniques with large skin incisions and largetissue trauma was considered in manycenters as the treatment of choice until the end of the 20th century and at the beginning of the 21st century. At the author'ssite, the preferredsurgicaltechniques for lumbardiscopathywerelargecutaneousincisions, extensiveparaspinalmuscledetachment, extensivefenestration (orfrequenthemilaminectomies / laminectomies). Whenremoving the disc hernia, a largeamount of disc mass was removed with the use of largespoons [10]. Currently, aggressivecurettageisabandoneddue to the increasedrisk of postoperativespondylodiscitis. It isworthemphasizingthat in the past, as anarchaicoperationaltechnique, spatialcurettage was anessential part of the procedure

(latin:*excochleatiospatiiintervertebralis,* ESI).Based on his own experience, the author (ZS) emphasizes that in the years 1998 - 2008 ESI (Figure 1) was the basis of the surgical operation in every discectomy. Each time ESI was coded in the register of medical procedures in the author's neurosurgical center (Department of Neurosurgery, Collegium Medicum, Nicolaus Copernicus University - CM NCU, Bydgoszcz, Poland).

Figure1. Surgicalspinalspoonusedwidelyduring ESI[1]

Goald, Wilson, Harbaugh, Maroon, and Abla, and otherauthors, haveconfirmed the ability to reduceincisionsize, bloodloss, and morbidityusing a microsurgicaltechnique as compared to archaicdiscectomytechniques [4-8]. According to theseauthors, successrates in microdiscectomyrange from 88 to 98.5% [6] in differentseries, althoughaccording to otherstudies the successrate of 75 to 80% is the moreaccurate and realisticexpectedresults [4].

[1]picture taken by the author (ZS) from the collection of neurosurgical equipment CM NCU, Bydgoszcz, Poland (author's own material)

Own experience over the years in a neurosurgicalcenter

We describeourownexperiences and document the changesmade in the surgicaltechniqueover the last 25 years (a quarter of a century). The Department of Neurosurgeryof CM NCU hasbeen a spinecenterrecognized in Poland since the 1990s. In it, spineprocedureswereperformed in it, whichwere modern and of the highestreferentiality in each period of time. The management of the centerat the turn of the century by prof. Heliodor Kasprzak hasmadeneurosurgeryat the NCU Center in the lastcentury the center of the highestreference in the cervical and lumbarspine [12]. Prof. Kasprzak was a student of prof. Jan Haftek, wholaid the foundations for modern spinesurgeryatthattime [13,14].Although the proceduresperformed in the lastcentury by J. Haftek and H. Kasprzak [13], nowadays (2021) arearchaic and historical, theyare a determinant of the objective development of procedures in the surgeryof the lumbarspine. We havedecided to focusthismanuscript on historicallumbarspineprocedures to makethiswork transparent and substantive. The cervicalspine, due to the largescope of knowledge and skills, hasitsownspecificity. Arranging the procedures of the lumbarspinealong with the cervicalspinewould be tooextensive and couldlosesense. We plan to cover the historicalprocedures of the cervicalspine in anotherpaper.

As initiallynoted in thismanuscript, a limitation in spinalprocedures in the past hasbeencaused bylimited X-rayfluoroscopyaccess. Therefore, it was

necessary to makelarge skin incisions. Incisions of morethan 15 cm werecharacteristic of even one-levelprocedures. Becauseit was necessary to palpate the correctlevel from the sacrumbone by neurosurgeon. The most favorablelevel was L5-S1, while the higher (L4-L5, L3-L4, L2-L3...) the accesseweregreater, the tissuetrauma was greater, and the probabilityofmistake was greater. Suchaccessesrequired the use of largetissuedilators and raspators to detach the paraspinalmuscles (Figure 2 A, B).

Figure2. A. selfretainingretractorused for extensive surgical approaches in the lumbar spine, B. tissue detacher for paraspinal muscles, named in the author's center as "shovel" in professional jargon[2]

The surgical techniques also involved obtaining bone access to the spinal canal and nerve structures. Today, high-speed drills (HSD) and Kerrison rongeurs are used for this. In times past, bone rippers were coarse and larger, and the Luerrongeurs (Figure 3) was commonly used. While the HSD and Kerissonrongeurs are adapted to microsurgical techniques and can be conveniently used under an operating microscope, the Luerrongeur is an evident macroscopic tool suited to larger cuts. Although the Luerrongeur is still used in justified cases (extensive laminectomies, urgent spine fracture operations), its use is now lesser and undoubtedly it is a symbol of the past neurosurgical technique.

Figure3. Luerbonerongeur (used for widespinalsurgicalapproaches)[3]

Discussion

A historical overview of the original descriptions of lumbar discectomy is provided, focusing on the evolution towards a less invasive surgical approach following the introduction of the operating microscope.

A studysimilar to our report was presented by Koebbe et al. (2002). In order to betterunderstand the history and learnmoreabout the firstmethods of treating a hernia of the lumbar disc and assess the influence of variousfactors in the modern and presentpractice of the spine, he made a research on thissubject in databases [15]. Koebbe et al. (2020) with the help of PubMed and Embase, he conducted a

[2]picture taken by the author (ZS) from the collection of neurosurgical equipment CM NCU, Bydgoszcz, Poland (author's own material)

[3]picture taken by the author (ZS) from the collection of neurosurgical equipment CM NCU, Bydgoszcz, Poland (author's own material)

search for the termsdiscectomy, medicalhistory, lumbarspinesurgery, intervertebral disc herniation, atherosclerotichernia, sciatica and lumbarradiculopathy [15]. Additionalsourceswereidentified from the literaturelists of peer-reviewedarticles.

Many older and ancient sources, including De Ischiade Nervosa, are available in English translations and have been used. In the absence of complete texts, an abstract in English was used [6,15]. According to commonly known facts, Koebbe et al. (2002) indicated that the first true, deliberate discectomy operation was performed by Mixter and Barr in 1932 [6, 13]. This means that at the time of publishing our manuscript, surgery for lumbar discopathy and stenosis has approximately 90 years of history. Compared to other topics in the history of medicine, these times are not so distant. Therefore, it seems all the more advisable to look at the changes taking place in the surgical technique at that time. We emphasize (partially philosophically and jubilee) that a similar work should be published in 2032, at the 100-year anniversary of the first lumbar disc surgery. Koebbe et al. (2002) pointed out that the Mixter and Barr surgical technique [13,15], although modified with improvements in illumination, magnification, and retractors, nevertheless remains the primary approach to disc hernias today. It can be summed up that in the subject of lumbar dysectomy, the accessories and measures have changed over the past 90 years, while the idea and template have remained the same all the time.

The development of spine implants is also important inhistorical aspect. Although the most commonlylumbar discectomy or stenosisdecompressiondoes not require implants(and has not requiredsince Mixter and Barr), in the case of injuries or neoplasms, it has always been necessary to provide elements for fusion [6,13]. Historically, these were autologous implants. In the second half of the twentieth century, frozen bone from corpses was also used, and from the 1970s, implants made of corundum ceramics. However, autologous transplants were of the greatest importance [16,17]. Bone blocks were collected from the fibulaand sometimes from the iliac crest (although ilium was more applicable in cervical procedures that are not the subject of this manuscript).

Conclusions

Historical surgical techniques in spine surgery rely on significantly larger tissue approaches and skin incisions. The idea of lumbar spinesurgery has remained the same for many years. Due to the use of a microscope, endoscope and fluoroscopy, nowadays skin incisions and tissue trauma are smaller. Hence, historical surgical techniques quantified more extensive ranges of surgery, which required more crude tools, with the qualitatively same treatment philosophy, essentially unchanged for years.

Abbreviations

- MIS - minimallyinvasivesurgery
- ESI(latin: excochleatiospatiiintervertebralis) - spatialcurettage
- CM NCU - Collegium Medicum, Nicolaus Copernicus University
- HSD - high-speed drills

Declarations

- Availability of data and materials: Allrelevant data arewithin the paper.
- CompetingInterests: The authorsdeclarethattheyhave no conflict of interest.

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