# SELECTED LECTURES

## ON SPINE SURGERY

# V.D. CHAKLIN'S METHOD OF ANTERIOR SPINAL FUSION

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The lecture presents the evidence of priority of V.D. Chaklin, outstanding Russian orthopedic and trauma surgeon, in developing and applying the method of anterior spinal fusion. The method became widespread around the world over the past 85 years and is used to treat spondylolisthesis, spinal osteochondrosis, intervertebral disc herniaton, scoliosis, spinal and facet stenosis, injuries, benign and malignant tumors, and some other pathological conditions of the spine. Spine surgeons using this method are able to operate on vertebral bodies and intervertebral discs of any localization.
**Key Words:** anterior spinal fusion, priority of V.D. Chaklin.

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*On the occasion of 125-anniversary of birth of Vasilii Dmitrievich Chaklin*

A famous orthopaedic and trauma surgeon of the XX century Vasilii Dmitrievich Chaklin (Fig. 1) was an outstanding surgeon, scientist, teacher, and organizer in health service settings. In 1931, he founded the Ural Institute of Traumatology and Orthopaedics, which now has V.D. Chaklin's name. V.D. Chaklin was the founder of the Ural and Moscow schools of orthopaedic and trauma surgeons and the author of 13 books, which for decades have been the major guidelines in traumatology and orthopaedics: "Perelomy kostei i ikh lechenie" [Bone Fractures and their Treatment] (1935), "Infektsionnye zabolevaniya kostei, sustavov i khryashchei" ["Infectious Diseases of Bones, Joints and Cartilages"] (1937), "Operativnaya ortopediya" ["Operative Orthopaedics"] (1951), "Ortopediya" ["Orthopaedics"] (1957), "Rukovodstvo po khirurgii" (XI–XII t., 1960) ["Guideline for Surgery", XI–XII vol. 1960], "Fundamentals of Operative Orthopaedics and Traumatology" [43], "Osteoplasty" [44], "Skolioz i kifozy" ["Scoliosis and Kyphosis"] (together with E.A. Abal'masova, 1973), "Opukholi kostei i sustavov" ["Tumors of Bones and Joints"] (1974). A quarter of a century after passing away, V.D. Chaklin's last book "Life, Quest, Encounters" was published [46]. Hundreds of V.D. Chaklin's articles were published in specialized journals that described, similar to the above-mentioned books, various challenges confronting the scientist throughout all his hectic and prolific life [45]. These facts are enough that orthopaedic and trauma surgeons will remember this name forever. In addition, surgery of the musculoskeletal system has a branch, today known as vertebrology, where V.D. Chaklin did particularly much. A method of posterior fusion to treat patients with various spinal disorders entered into use following Hibbs (1911) and Albee (1912). Rayerson [71] and Scherb (1921) operated on patients with spondylolisthesis using this approach. Various modifications were proposed: Henle and Whitman (1912), A.A. Kozlovskii (1930), Gibbson (1931), Meyerding (1932), Bosworth (1942) and others. Posterior spinal fusion was the only method in spine surgery for twenty years.

However, in 1931, V.D. Chaklin proved that posterior spinal fusion has an alternative procedure – anterior spinal fusion. V.D. Chaklin was the first in the world to perform an anterior spinal fusion operation to a 17-year-old female patient with anterior L5 vertebral displacement – spondylolisthesis using an extraperitoneal approach to vertebral bodies and intervertebral discs of the lumbosacral spine on June 28, 1931.

This is how this operation was described in journal No. 2, which was started on June 25, 1931 and finished on March 4, 1932 (Fig. 2):

"Full name: Artem'eva Iraida Osipovna. Diagnosis: Spondylolisthesis. The name of the operation was Arthrodesis intervertebralis L5 et S1. Laminectomy. Ether anaesthesia. The surgeon Chaklin, assistants: Kasakov, Apasova.

An about 18 cm incision parallel to the left Poupart's ligament at two finger breadths inward was made. Skin, subcutaneous tissue and tendon were dissected. Dissection of *musc. oblig. abdominis* was performed. The underlying muscle was sharply dissected along the entire wound length. The peritoneum was moved up and the bladder with the ureter was moved to the medial side. This exposed a space surrounded externally with *m. psoas*, surrounded from inside with *art. epigastrica* and posteriorly with vertebral bodies. Following preliminary ligation of three veins, slight hemostasis, an arterial vessel was taken and pulled inwards and down using hooks. The front surface of L4 and a part of L5 vertebra became naked. One wedge resection of

**Fig. 1**
Vasilii Dmitrievich Chaklin (1892–1976)

cartilage and a part of skin from the interval between L4 and L5, L5 and S1 was performed. Elevation of extremities and the pelvis brought to some extent together these vertebrae. Thereafter, an incision was made parallel to spinous processes at two-finger breadths to the left side of L2 to S1. Skin, subcutaneous tissue and muscle tendons connected to the spinous processes were incised and were cut from L3 to including S1 from both sides. The spinous process of L5 and vertebral arch were removed with forceps. Bleeding was stopped. Both wounds were sutured with tight closure. The patient in bed was placed supine with a slightly raised pelvis and flexed hips".

The operation journal shows an illustration of the operation. V.D. Chaklin demonstrated the operation procedure in May 1932 at the exhibition of the XXII All-Union Congress of Surgeons in Moscow. In 1933, V.D. Chaklin published a paper "A new method of spinal surgery" in "Proceedings of Research Institute of the Ural Regional Health Department" [40]. The mentioned paper gives a detailed description of an anterior spinal fusion procedure involving replacement of a bony void formed after the resection of intervertebral disc and segments of vertebral bodies using bone autograft (Fig. 3). In addition, the tactics of postoperative management of the patients is described in detail (Fig. 4). The paper presented the results of experimental studies of this method using 18 dogs evidencing the occurrence of fusion after the operation. Medical records for five patients operated on in 1931–1932 were also provided. The content of the paper, including figures, is given in the book by Glorieux and Roederer "La spondylolyse et ses consequences. Spondylolisthesis. Scoliose listhesique" published in Paris in 1937 [58].

In 1939, the journal "Vestnik khirurgii im I.I. Grekova" published an article by V.D. Chaklin "Author's radical operation for spondylolisthesis and tuberculous spondylitis" [41]. The

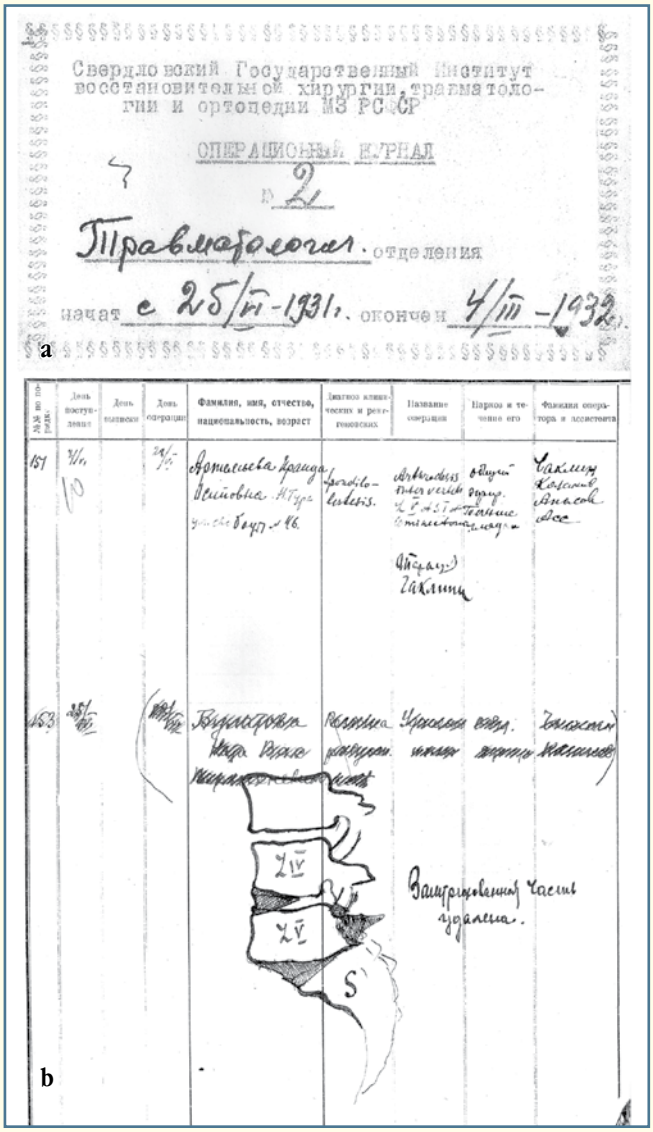


**Fig. 2**
The title page of the operation journal of the Traumatology Department of the Ural Institute of Traumatology and Orthopaedics started on June 25, 1931 **(a)** and the first page describing the operation of anterior spinal fusion with an illustration of the operation **(b)**

paper reported about 25 successfully operated patients. The author considers it possible to perform operations using the proposed method in cases of "spondylolisthesis with injuries to the intervertebral cartilage with persistent pain, chronic lumbar arthrites and in some cases of spondylitis with isolated injury to one or two lumbar vertebrae".

Having an experience of sympathectomy using extraperitoneal approach to the sympathetic chain, Ito et al. [61] decided to help a 29-year-old patient with L1, L2 tuberculous spondylitis by operating using an anterior approach. The operation was performed on May 4, 1932. The pathological

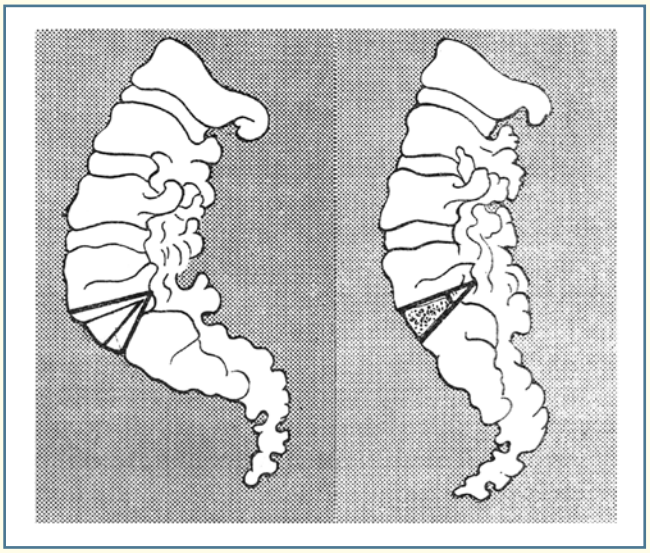

**Fig. 3**
Illustration depicting the Chaklin's method of anterior spinal fusion

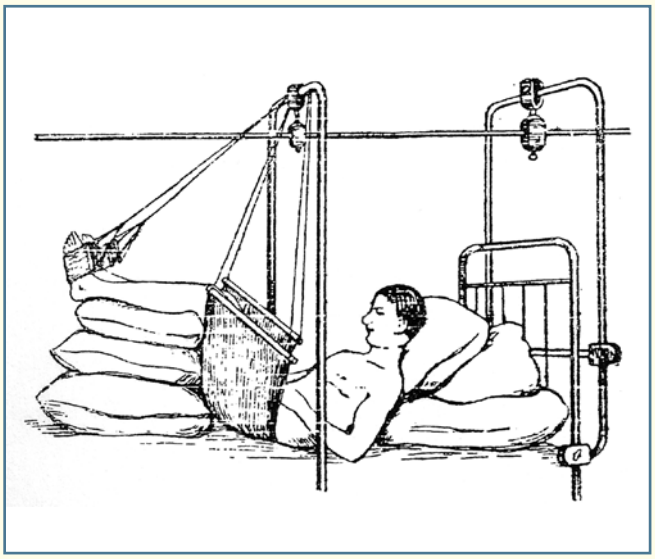

**Fig. 4**
Position of the patient in bed after the Chaklin's method of anterior spinal fusion

focus (purulence, caseation, and granulation) was removed; spinal bony void was filled and strengthened with a tibia bone graft (Fig. 5). The outcome of surgery was favorable. The authors operated on 10 patients up to January 25, 1933; favorable outcome was not achieved in only two of these patients. They wrote a paper "A new radical operation for anterior Pott's Disease. Report of ten cases" [61], which was sent to Journal "Bone Joint Surgery". The paper was received by the journal editorial office on August 29, 1933 and was published in 1934.

In March 1933, Burns [51] operated a female patient with L5 spondylolisthesis using transperitoneal left-sided paramedial approach to the lumbosacral spine. A canal between the iliac vessels was drilled through the L5 vertebral body into the S1 vertebral body and spinal fusion using tibia autograft was performed (Fig. 6). However, there was no favorable outcome and the patient began again to suffer from lumbar pain 2 months after the operation. In 3 months, the article was published in the Journal "Lancet". This journal, which was published as early as since 1823, was generally available to medical audience.

It is possible that Burns followed the recommendation of his fellow citizen Capener [52], who had published an article on spondylolisthesis a year earlier in the "British Journal of Surgery". The author suggested that it is reasonable to transfix the displaced L5 vertebral body to the S1 vertebral body and achieving fusion between the both halves of the separate vertebrae (Fig. 7).

In December 1936, Jenkins [62] operated a 16-year-old adolescent with spondyloptosis using the Burns technique. In the same year, a paper by Mercer [67] describing the operations of two patients with spondylolisthesis using an anterior approach was published. He actually performed an

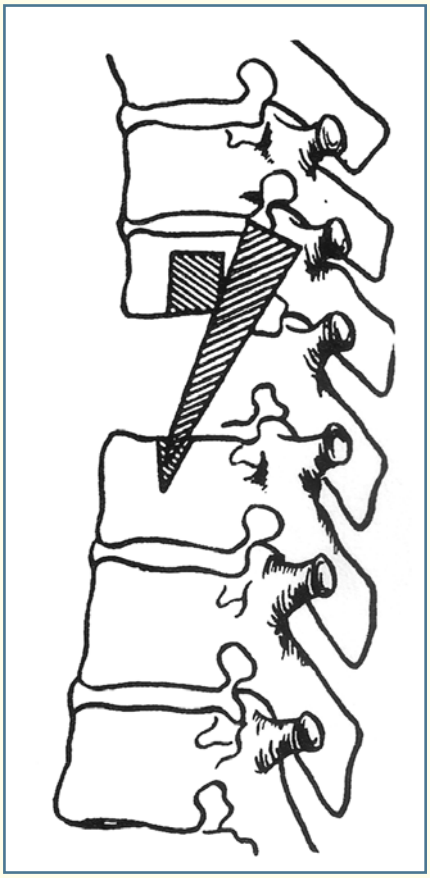

**Fig. 5**
Illustration of anterior spinal fusion performed by Ito et al. [61]

operation according to the Chaklin's method because he resected intervertebral disc and filled the bony void with two iliac crest grafts.

Similar single surgeries were performed by Friberg [56], Henschen [59], Ramser [70], Brunner [50], Lob [64], Vos [77], Lane and Moore [63], Schuller [72].

In 50–60-ies of the XX century, many researchers tried to use anterior spinal fusion to treat patients with spondylolisthesis: Merle d'Aubigne [68], Gjessing [57], Ingerbrigsten [60], Taillard [74], Wiltberger [78], Domisse [54], Debeyre [53], Sijbandij [73], Urist [75], Verbiest [76] and others. The following decades witnessed the appearance of many intriguing reports in different countries on various aspects of using anterior spinal fusion: Freebody [55], Newman [69], Chow (1980), Zippel [80], Loguidice [65], Brantigan, Steffee (1993), Mayer [66], Wolf [79], Elias (2000), Barrick (2000) and others.

In Russia, much time passed after the V.D. Chaklin's publications on anterior spondylolisthesis (1931, 1939) before the issue of anterior spondylolisthesis received intense development, probably, due to publishing of a V.D. Chaklin's book "Operativnaya khirurgiya" ["Operative Surgery"] in 1951 and publication of his article "On surgery of the spine' [42].

In the clinic of Children's Orthopaedics and Traumatology at the Central Institute of Traumatology and Orthopaedics, on the basis of Moscow Orthopaedic Hospital, V.D. Chaklin and his scholar I.M. Mitbreit in 1959 continued studying the issue of spondylolisthesis. The results of these studies are shown in a series of publications [26–28], in the doctoral thesis by I.M. Mitbreit "Spondilolistez: Patogenez, klinika, lechenie" ["Spondylolisthesis: Pathogenesis, Clinic, and Treatment"] (1969), as well as in a monograph [29]. A significant part of these papers was devoted to anterior spinal fusion. At the Department of Traumatology, Orthopaedics and Disaster Medicine of the First Moscow Medical Institute named after I.M. Sechenov, G.S. Yumashev and his colleagues studied spinal osteochondrosis

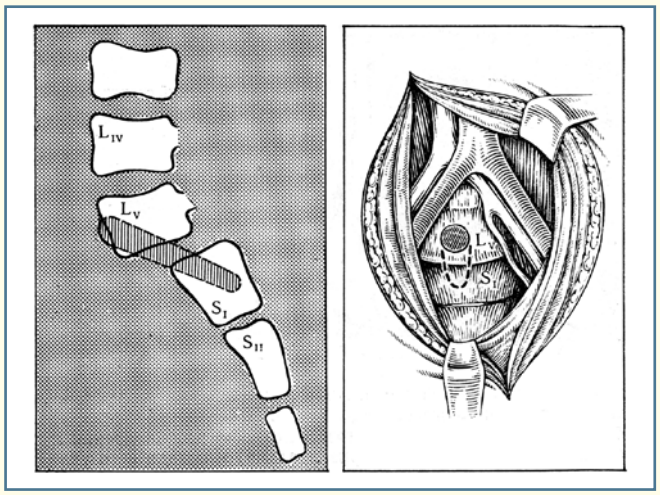


**Fig. 6**
Illustration of anterior spinal fusion operation performed by Burns [51]

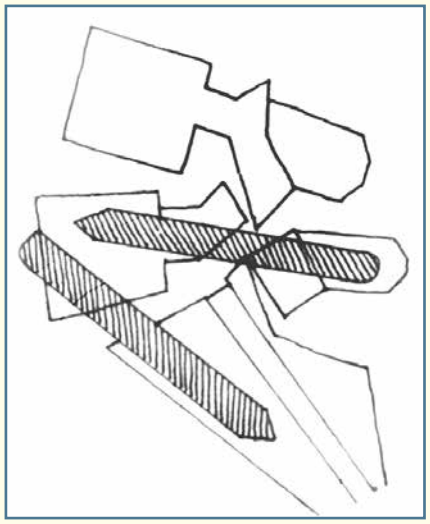

**Fig. 7**
Illustration of Capener [52] recommended for operation on patients with spondylolisthesis

and spondylolisthesis successfully using the method of anterior spinal fusion since 1962 [48, 49].

In the Ural Institute of Traumatology and Orthopaedics named after V.D. Chaklin, where the first operation of anterior spinal fusion was performed, this issue was handled by D.I. Glazyrin [6–9]. The materials of his scholars are published up to today.

Various aspects of the spinal pathology, including anterior spinal fusion, are studied at the Novosibirsk Institute of Traumatology and Orthopaedics named after Ya.L. Tsivyan. In 1966, Ya.L. Tsivyan [39] described the technique of anterior spinal fusion that he used in patients with III–IV grade of spondylolisthesis. In a series of publications on anterior spondylolisthesis, in particular, on spinal instability, and in the book "Surgery of the Spine", Ya.L. Tsivyan presented the use of anterior spinal fusion method in patients with scoliosis, spinal fractures, and other diseases of this localization. The research started by Ya.L. Tsivyan on surgery of the spine within the anterior column continue also at present [30, 37].

In the Kharkov Institute of Spine and Joint Pathology named after M.I. Sitenko, intensive research on using anterior spinal fusion for spondylolisthesis and other pathological conditions of the spine has been performed since the early 60-ies of the XX century [19–21]. The distribution of the anterior spinal fusion method was greatly facilitated by books of A.A. Korzh et al. "Surgical approaches to thoracic and lumbar vertebrae" [20], N.I. Khvisyuk et al. "Degenerative spondylolisthesis" [38].

At the Department of Traumatology and Orthopaedics of Novokuznetsk Institute of Advanced Medical Education, the anterior spinal fusion method was widely used by A.I. Osna in the treatment of patients with lumbar spinal osteochondrosis. The results of the study are published in articles and a monograph "Surgical treatment of lumbar degenerative disease" [32–34].

At the Department of Neurosurgery of the same institute, the issue of anterior spinal fusion is investigated in patients with spondylolisthesis [23] and with lumbar disc herniation [24].

L.K. Zakrevsky (Children's Orthopaedic Institute named after G.I. Turner) in 1987 published an article on the use of anterior spinal fusion in children and adolescents with spondylolisthesis [17]. In the Russian Institute of Traumatology and Orthopaedics named after R.R. Vreden, the issue of anterior spinal fusion in patients with spondylolisthesis is reported in a paper by V.A. Kostin et al. [22]. In Vitebsk, M.A. Nikolsky [31] performed research on the issue of anterior spinal fusion, M.F. Durov [16] – in Tyumen, and N.P. Demichev [11] – in Astrakhan.

Over the past quarter of the century vertebral surgeons began practicing transpedicular spinal fusion. However, the experience shows that the outcome of the operation turns out to be failed in several patients after some time because of screw fracture and break of the entire construct. It was concluded that the cause is the lack of stability of the anterior spinal column. The solution was found in the use of cages placed into the intervertebral space through a posterior approach. Some surgeons perform an operation of anterior spinal fusion using one of the anterior approaches at the second stage [25].

A principle of less traumatic surgery on vertebral bodies and intervertebral discs has been increasingly used. For this, small sized anterior approaches to the spine with minimal tissue injury have been proposed. Anterior spinal fusion is performed as an independent surgery. When necessary, a surgeon performs neurosurgical manipulations without opening the dura mater, which prevents against the formation of intravertebral fibrosis. Disc herniation (including foraminal) is removed via expansion of vertebral and facet canals. The same effect is achieved in different forms of spinal stenoses, including congenital, and the operation is finished with creating an anterior spinal fusion [12–14, 18, 66].

Anterior spinal fusion is performed in spinal injuries [5, 35]. This is especially true for splintered fractures of the vertebral bodies accompanied by spinal canal stenosis and concomitant spine and spinal cord injury [10]. Anterior approach to vertebral bodies is used to treat patients with benign and malignant diseases of the spine [1–3, 15, 36, 47]. The method of anterior spinal fusion is used in the treatment of patients with inflammatory diseases of the spine, primarily of the tuberculous origin [4].

## Conclusions

The V.D. Chaklin's method of anterior spinal fusion took a strong place in the arsenal of tools used by vertebral surgeons in the treatment of patients with various spinal pathologies. The method is constantly improved. The combination of auto- and allografts (intrabone, extrabone, intervertebral) gave the possibility of creating initially stable anterior fusion.
Spinal surgeons will always remember V.D. Chaklin as the creator of an anterior spinal fusion method, which provides the basis for the development of current spine surgery.

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