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Historical Perspective

History of Spine Deformity in Turkey

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ABSTRACT

Spine deformities are among the most important spinal disorders, affecting health-related life quality. Although there are some studies in past centuries, most spine deformity-related studies and research has started in the last century. Many surgical techniques, performed between 1960 and 1990, made scoliosis a touchable pathology. These techniques started with Harrington's system, wiring techniques, pedicle screw techniques, and all other universal techniques. Anterior and 360 degree techniques contributed to this process. The use of spinal osteotomies, and recent technologies such as magnetic rods, intraoperative neuromonitoring added much to the body of knowledge of literature and improved the outcome. Advancement has not been limited to surgery only and diagnostic advancements had also impact to this process. Surgical techniques performed in the west have been performed soon in our countries. Currently almost all surgical techniques for treatment of spine deformities can be performed in our country. This article reviews historical aspects related to the diagnosis and treatment of spine deformities in Turkey.

KEYWORDS: History of medicine, Kyphosis, Scoliosis, Spine deformity

■ INTRODUCTION

Spine deformities are among the major pathologies that affect human health. Although the contemporary treatment method for this disease started to take shape in the 20th century, knowledge on the subject has a long past in which Anatolian physicians play a prominent role.

We come across Hippocrates of Kos (460-370 BC) as the first physician to treat spine deformities. In his work, "On the Nature of Bones", Hippocrates defined spinal anatomy and spine deformities, describing treatment by axial traction and direct pressure on the deformity (54,64). Galen of Pergamum (129-201 AD), the Roman physician, gathered spinal deformity under four main headings, namely kyphosis, lordosis, scoliosis and spinal joint mobility without deformity (65). He also described the spine and the spinal nerves in further detail.

It is understood from his famous work "Cerrahiyetü'l Haniyye" (Imperial Surgery) written in the late 15th century that Ottoman physician Şerefeddin Sabuncuoğlu applied cauterisation for lumbar pain (68). In fact, this work is an illustrated translation into the Ottoman language of Andalusian physician Al

Zahrawi's book on surgery written in Arabic. Other than these, as in the rest of the world, no treatment for scoliosis worth mentioning can be found in our civilisation at that time. Indeed, it is known that in the 16th century, Suleiman the Magnificent's son Prince Cihangir (1531-1553) had a spine deformity which could not be treated.

Although the first modern school of medicine in the Ottoman Empire was founded 14 March 1827, contemporary western surgical approaches were only able to develop by the late 19th century. The first laminectomy in our country was performed in the late 19th century, but no procedures were attempted to treat scoliosis. The Ankara, Istanbul and Ege Universities played a pioneering role in scoliosis cases. It is likely that conservative procedures were performed to manage scoliosis at the Baltalimanı Bone and Joint Hospital founded in 1944 and the Eğirdir Bone and Joint Hospital founded in 1952.

■ CONSERVATIVE TREATMENT

The first treatment approaches with respect to scoliosis were in the form of exercises, physical therapy and casting.



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However, no information is available on the date and method of the first casting and orthosis procedure. What is known is that Prof. Dr. Rieder Pascha, the first director of the Gülhane School of Medicine, founded in 1898, fell and broke his back and leg while inspecting the construction site of the Haydarpaşa Faculty of Medicine, which led to the opening of the first orthosis-prosthesis workshop. This first workshop was founded by Hüseyin Bey and Rifat Bey under the name "Tersane-i Alat-ı Nazikiye" (Workshop for Fine Tools), and was incorporated into Gülhane in 1914 (13). This workshop was followed by other public and private workshops, and orthoses were made for scoliosis patients.

The statistics section of Gülhane-Festschrift written by Wieting Pascha (Figure 1) mentions, along with many statistics, that



Figure 1: Wieting Pascha.

3 scoliosis patients underwent laminectomy in the previous year. The book also contains a case presentation under the title "congenital scoliosis" (88). This section of the book is one of the first writings on scoliosis in our country (Figures 2 A and B).

Similarly, a French medical journal published in Istanbul in those days reported a scoliosis case that was treated through gymnastics (77).

The first corrective-tractive cast (turn buckle cast) in the world was used in the 1920s, and Hibbs, Risser and Ferguson published a series comprising 360 patients in 1931 (53). Risser modified this cast in 1955 (79). No article on this subject dating to the 1940s and 1950s is found in our country. The only related study is from 1960 where Alpsoy (Figure 3) reports cases in which the Risser cast was used (10). In 1962 Alpsoy attended the German Orthopaedic congress held in Munich, where he presented a report on scoliosis, and in 1963 he presented the results of 25 scoliosis cases treated using the Milwaukee corset, which he monitored for a period of 5 years (Figure 4) (11).

■ THE FUSION ERA

The world's first spinal fusion procedures were performed in 1911 (6,52), while the first operation of this kind to be carried out in Turkey was performed in 1925 by Mim Kemal Öke (Figure 5) (59). Burhanettin Toker also performed a fusion procedure in 1926 (20). These two fusion cases involved the fusion techniques described by Albee, and were performed spinal infection cases. However, this procedure remained sporadic as well as being mostly performed for tuberculosis (67). In the early 1960s, modifications of the Albee procedure were performed both for tuberculosis cases and for traumas and deformities. These procedures were performed by Dr. Baha Oskay at Baltalimanı Bone and Joint Hospital, Dr. Orhan Aslanoğlu at Eğirdir Bone and Joint Hospital and Dr. Ridvan

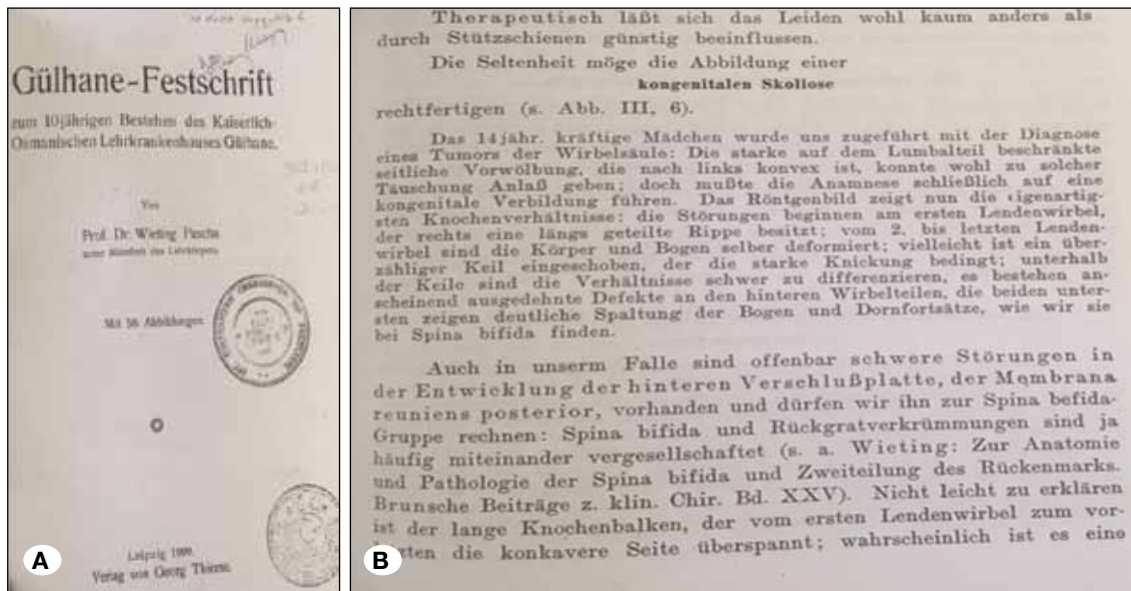


Figure 2: A) Inner cover of the work Gülhane-Festschrift. B) Book section entitled congenital scoliosis.

Ege at Ankara Gülhane Military Medical Academy Hospital (39,40,67,72). In his 1960 article entitled «new views on the treatment of scoliosis,» Cevat Alpsoy indicated that the contemporary treatment for scoliosis was «corrective casting and fusion», recommending that «spine deformities should be especially checked during school health examinations» (10). In 1965 at Ankara Gülhane, Rıdvan Ege performed the first anterior fusion procedure in a spinal tuberculosis case (40).

■ THE HARRINGTON-LUQUE PERIOD

Harrington performed the procedure, which would subsequently be named after him, for the first time in 1958, publishing his first series in 1962 (51). The first surgical procedures for scoliosis in our country were carried out by Prof. Dr. Güngör Sami Çakırgil (Figure 6), Prof. Dr. Bahattin Oğuz Temuçin (Figure 7) and Prof. Dr. Yücel Tümer. The first Harrington-type instrumentation was made by Dr. Güngör



Figure 3: Dr. Cevat Alpsoy.

Sami Çakırgil in 1969 in Ankara. In 1985 Çakırgil reported 585 scoliosis cases operated on between 1969 and 1985 (24).

Subsequently, use of the Harrington procedure started at other centres too (34). By the end of 1969, Dr. Hüsametdin Altav operated on four scoliosis cases in İstanbul (12). Following these first cases, Harrington procedures were performed in

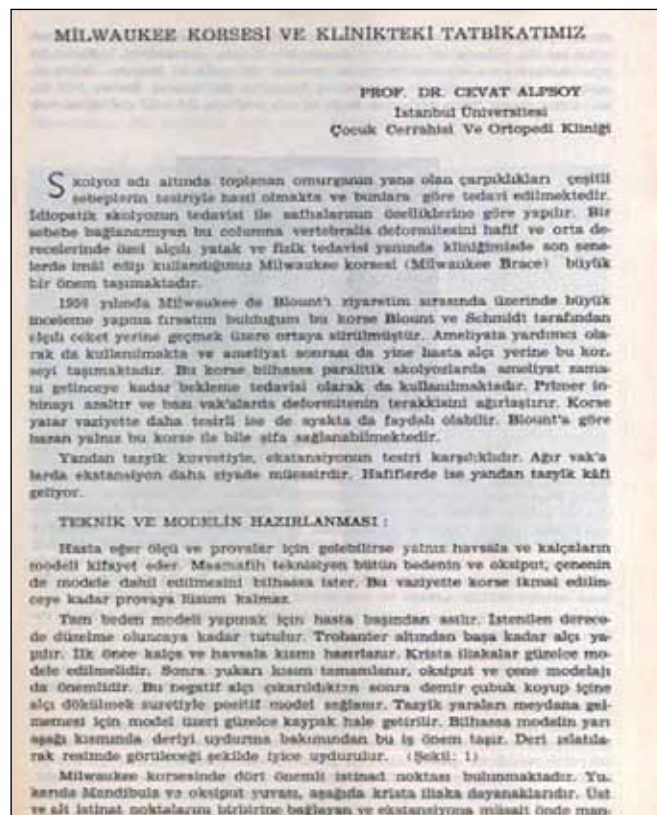


Figure 4: Dr. Alpsoy's article.



Figure 5: Dr. Mim Kemal Öke.



Figure 6: Dr. Güngör Sami Çakırgil.



Figure 7: Dr. Bahattin Oğuz Temoçin.

1970 in Istanbul by Dr. Temoçin, in 1972 in Izmir by Dr. Mehmet Tiner and in 1974 at Hacettepe by Dr. Nejat Tokgözoğlu (*Personal communication with Dr. Adil Surat on 15.08.2016*) (85). The first Harrington Cotrel procedure was performed by Dr. Yücel Tümer in 1981 (*Personal communication with Dr. Yücel Tümer on 03.08.2016*).

The first sublaminar wiring for scoliosis was reported by Luque in 1982 (63), and this operation was performed for the first time in Turkey by Dr. Nafiz Birsal in 1989 at the Hospital of Cerrahpaşa School of Medicine (18).

The Drummond technique was applied for the first time in 1987 by Dr. Azmi Hamzaoğlu (50). In 1989 Dr. Çakırgil reported the results of the Harrington-Luque procedures (26).

■ THE PEDICLE SCREW ERA

When it was found in the 1980s that scoliotic deformity is three-dimensional, third-generation instrumentation systems (Cotrel-Dubousset, TSRH, Isola) allowing correction on the coronal, sagittal and axial planes were developed (43,56,66). Although the first pedicle screw was developed in 1959 by Boucher, it had not seen widespread application (19). From 1963, Roy-Camille fixed the screws inserted into the pedicle using a plate, publishing his first results in 1970 (80). Interest in pedicle screws increased following that article.

The first results of the Cotrel-Dubousset system, which is one of these third-generation instrumentation systems, were published for the first time in 1988, which earned the system popularity in a short space of time (22).

In our country, the first pedicle screw was applied in the 1980s. This first procedure was performed using Schanz screws. The first pedicle Schanz screw was made in 1988 after the AO course held in Izmir, by Dr. Derya Dinçer and Dr. İlker Çetin from Ankara University, after receiving training from

the Swiss Walter Dick, the designer of the system (*Personal communication with Dr. Derya Dinçer on 02.08.2016*) (33). The same procedure was performed towards the end of 1988 by Dr. Mazhar Tokgözoğlu and Dr. Haluk Berk from Hacettepe University, and by Dr. Osman Güven in Istanbul (*Personal communication with Dr. Derya Dinçer and Dr. Haluk Berk on 02.08.2016*).

The first pedicle screw applications under the CD system were performed in November 1988 by Dr. Ömer Çeliker (29,30,40) in Ankara and by Dr. Ünsal Domanıç in Istanbul, almost on the same dates (35,36) (*Personal communication with Dr. Teoman Benli, Dr. Osman Güven and Dr. Derya Dinçer on 02.08.2016, Dr. Ünsal Domanıç on 03.08.2016, and Mr. Mehmet Elestekin on 02.08.2016*). After this, the CD operation became widespread, being performed in 1989 by Dr. İlker Çetin in Ankara (31) and by Dr. Osman Güven in Istanbul (*Personal communication with Dr. Osman Güven on 02.08.2016*).

The first stabilisation using TSRH was performed in 1991 at the Dışkapı SSK Hospital by Dr. Teoman Benli and Dr. Mert Tüzüner (*Personal communication with Dr. Benli on 02.08.2016*). From 1997 Dr. Cüneyt Şar regularly used reduction screws for sagittal deformities (*Personal communication with Dr. Cüneyt Şar on 11.08.2016*).

■ ANTERIOR PROCEDURES

In 1964, Allen Dwyer described the anterior approach in scoliosis treatment, claiming that this approach would ensure correction with less construction (38). In the following years anterior procedures were carried out using different rods, wires and cables, which were subsequently combined with posterior procedures.

The first anterior fusion related to spinal infections in our country was performed by Dr. Güngör Sami Çakırgil (25), and the first procedures for scoliosis cases were performed subsequently. Anterior surgery in scoliosis was performed in Turkey for the first time in 1972 by Dr. Güngör Sami Çakırgil, who returned to Turkey after completing his education in Hong Kong (*Personal communication with Dr. Orhan Girgin on 05.08.2016*). From 1974, anterior procedures have been performed regularly by Dr. Emin Alici in Izmir and later by Dr. Ünsal Domanıç in Istanbul (*Personal communication with Dr. Ünsal Domanıç on 03.08.2016*). Following its first performance in 1976 in Germany, the Zielke procedure for idiopathic scoliosis (anterior instrumentation and correction) (94) was performed in our country in 1991 by Dr. Azmi Hamzaoğlu. The first thoracoscopic deformity surgery aimed at relaxation was performed in 1993 by Dr. Emin Alici, while the first thoracoscopic screw application was carried out in 1994, again by Dr. Emin Alici (8,9). In the surgical treatment of scoliosis, selective anterior thoracic fusion in dual deformities was first performed by Dr. Azmi Hamzaoğlu in 1994 (*Personal communication with Dr. Azmi Hamzaoğlu on 10.08.2016*).

■ COMBINED PROCEDURES

Combined procedures started in the 1980s. From 1989, Dr. Gülşen performed combined anterior and posterior procedures

on selected cases (47,49). Again from 1989, combined procedures had been applied by Dr. Benli to the Scheuermann kyphosis in Ankara Dışkapı (17). Combined procedures on rigid cases were also reported by Dr. Şükrü Solak and his colleagues from 1991 (82). Dr. Amzi Hamzaoğlu performed combined anterior and posterior surgery in scoliosis surgery (anterior discectomy+release+fusion+posterior instrumentation and correction using 1st generation CD) in 1990 and a combined anterior-posterior convex hemiepiphysiodesis procedure in 1991 (*Personal communication with Dr. Azmi Hamzaoğlu on 10.08.2016*).

■ OSTEOTOMIES

Osteotomies in spine deformities started to be performed in our country in the 1960s. The first procedures on kyphotic deformities were performed by Dr. Orhan Aslanoğlu (Figure 8) in 1961, and this study was published in 1963 (14). In 1971 Dr. Ali Akçiçek (Figure 9) presented 53 kyphosis cases on which he performed vertebral Herbert osteotomy (Figure 10) (3). In scoliosis, however, a rigid osteotomy was performed for the first time in 1990 by Dr. Ünsal Domaniç under the name “total wedge resection (Domaniç) osteotomy.” In 2004, Domaniç et al. published the results of the 32 cases on which they operated between 1990 and 2000 (37).

In 1990, anterior multiple osteotomy+posterior osteotomy and correction of congenital lordoscoliosis was performed by Dr. Azmi Hamzaoğlu. In 1992 anterior-posterior combined hemivertebra resection was also performed for the first time by Dr. Azmi Hamzaoğlu (*Personal communication with Dr. Azmi Hamzaoğlu on 10.08.2016*).

Dr. Mahir Gülşen performed the first eggshell osteotomy in 1991, which he published in 1992. Later, he applied the same method to the cervical spine in cases of ankylosing spondylitis (45-48).

Posterior hemivertebra resection (1994), the application of Posterior Vertebral Column Resection (PVCR) (1997) in the surgical treatment of advanced spine deformities, and Ponte osteotomy (1998) applications in the surgical treatment of scoliosis were first performed by Dr. Azmi Hamzaoğlu (*Personal communication with Dr. Azmi Hamzaoğlu on 10.08.2016*).

■ OTHER DEVELOPMENTS

In 1991, Dr. Azmi Hamzaoğlu became the first in the world and in Turkey to use a traction film under general anaesthesia and intraoperative traction in assessing scoliosis (*Personal communication with Dr. Azmi Hamzaoğlu on 10.08.2016*).

The wakeup test was performed for the first time in our country in 1989 by Dr. Nafiz Birsal (*Personal communication with Dr. Nafiz Birsal on 03.08.2016*). Intraoperative neuromonitoring, however, was performed for the first time in 1989 at Gülhane Military Medical Academy Hospital by Dr. Kaplan and his colleagues (58). In this study Kaplan and his colleagues performed neuromonitoring using a somatosensory evoked potential during scoliosis surgery. A similar application was carried out in 1991 at Dokuz Eylül University. The first

neuromonitoring using motor evoked potential was performed in 2003 by Dr. Azmi Hamzaoğlu (*Personal communication with Dr. Azmi Hamzaoğlu on 10.08.2016*).

The extreme lateral interbody fusion (XLIF) application in scoliosis surgery was first performed in 2008 by Dr. Azmi Hamzaoğlu, was then applied by Dr. Cüneyt Şar at Istanbul University, and is now increasingly being performed at many



Figure 8: Dr. Orhan Aslanoğlu.



Figure 9: Dr. Ali Akçiçek.

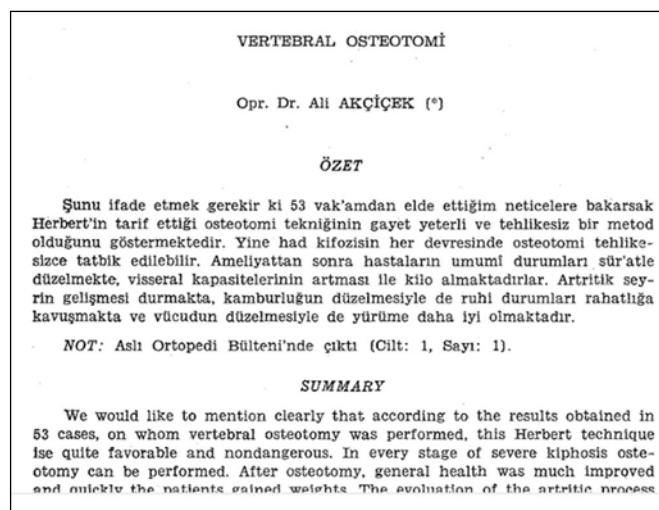


Figure 10: Title of Dr. Akçiçek's article.

centres (Personal communication with Mr. Kaşif Alp Seval).

Stabilisation with magnetically-controlled growing rods was first applied in 2010 by Dr. Muharrem Yazıcı (Personal communication with Mr. Sinan Kazmacı).

In recent years neurosurgeons have also started to tend to perform spinal surgery. Neurosurgeons, who actually played a pioneering role in degenerative and cervical spine surgery, started to show interest in thoracolumbar instrumentation in the late 1980s, the first studies being published in 1989 (78). In the 1990s, spinal instrumentation was applied to many pathologies (69,81). From the mid-1990s, neurosurgeons performed procedures chiefly in thoracolumbar trauma and lumbar degenerative scoliosis. The first paediatric scoliosis procedure was performed in 1996 by Dr. Zileli (Personal communication with Dr. Zileli on 16.08.2016). Especially in recent years, complex instrumentation and osteotomies have been performed on paediatric and adult scoliosis and kyphosis cases at many neurosurgery centres (5,15,23,27,28,41,42,58,61,73,74,89-92,95). Many spine deformity courses are held due to the interest in spine deformity, and physicians become members of associations such as the Scoliosis Research Society, participating in studies.

■ SCOLIOSIS SCREENING

The first scoliosis screening in our country was performed in 1982 by Sırrı Aksu for a dissertation study (4). In the 2000s, similar studies were seen to be performed at province and district level (1,16,21,44,55,60,75,76,84,86,93).

■ PUBLICATIONS on SPINE DEFORMITIES

In our country, over 40 dissertations have been written on

scoliosis and other spine deformities. Most of these comprise clinical research.

In the last 50 years, 77 books were published in our country on spinal health and diseases (70). Three of these books are on spinal deformities. These are *Omurga hastalıkları ve deformiteleri (Spinal Diseases and Deformities)* by Prof. Dr. Emin Alıcı (1991) (Figure 11A) (7), *Spinal deformiteler (Spinal Deformities)* by Dalbayrak et al. (2015) (Figures 11 A,B) (32), and *Omurganın sagittal plan deformiteleri (Sagittal Plane Deformities of the Spine)* (2016) published by Üzümcügil et al. (Figure 11 C) (87). There are also three books, one translated from Lehnert-Schroth's English book by Dr. Gülseren Kayalar entitled as *Skolyozun üç boyutlu tedavisi (Three-dimensional treatment of scoliosis)* (62) (Figure 12A), and two English books, one edited by Akbarnia, Yazıcı, and Thompson, *The growing spine* (2) (Figure 12B), and other edited by Yazıcı, *Non-idiopathic scoliosis in young children* (91) (Figure 12C). Other than these academic works, İffet Oral and Nazan Özen published a children's book titled *Skolyoz (Scoliosis)* in a children's stories series (71) (Figure 13). Finally, the Turkish Spine Society is currently preparing a book titled *İdyopatik skolyoz (Idiopathic Scoliosis)* for publication in 2017.

■ AFTERWORD

Spine deformities cause serious health problems, but in the meanwhile new treatment methods are being developed. It is observed that Turkish surgeons follow developments in the world in deformity surgery, and that the techniques developed are applied in our country without delay. It is understood that our surgeons have recently been playing a pioneering role in spine deformities as in all secondary branches of spinal surgery.

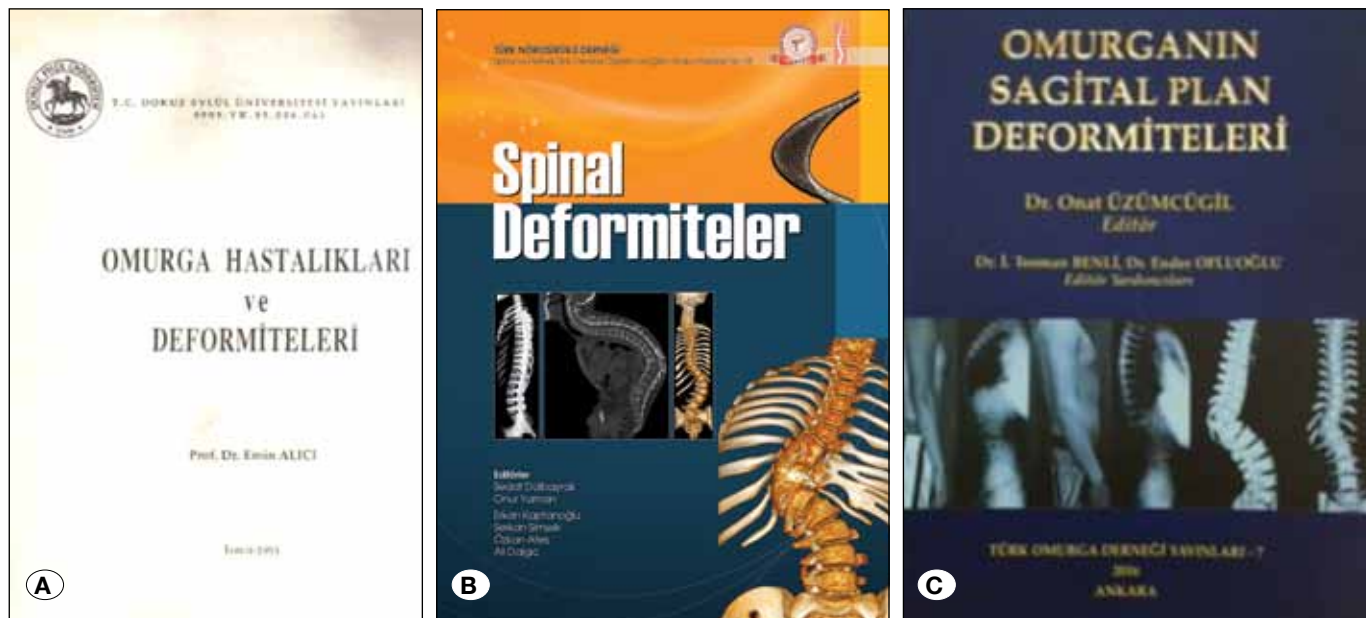


Figure 11: **A)** Cover of Dr. Emin Alıcı's book (Spinal diseases and deformities), **B)** Cover of the book edited by Dalbayrak et al. (Spinal deformities), **C)** Dr. "Cover of the book edited by Üzümcügil et al. (Sagittal plane deformities of the spine).



Figure 12: **A)** Cover of the book translated by Kayalar (Three-dimensional treatment of scoliosis), **B)** Cover of The growing spine edited by Akbarnia, Yazıcı and Thompson, and **C)** Cover of Non-idiopathic scoliosis in young children edited by Dr. Muharrem Yazıcı.

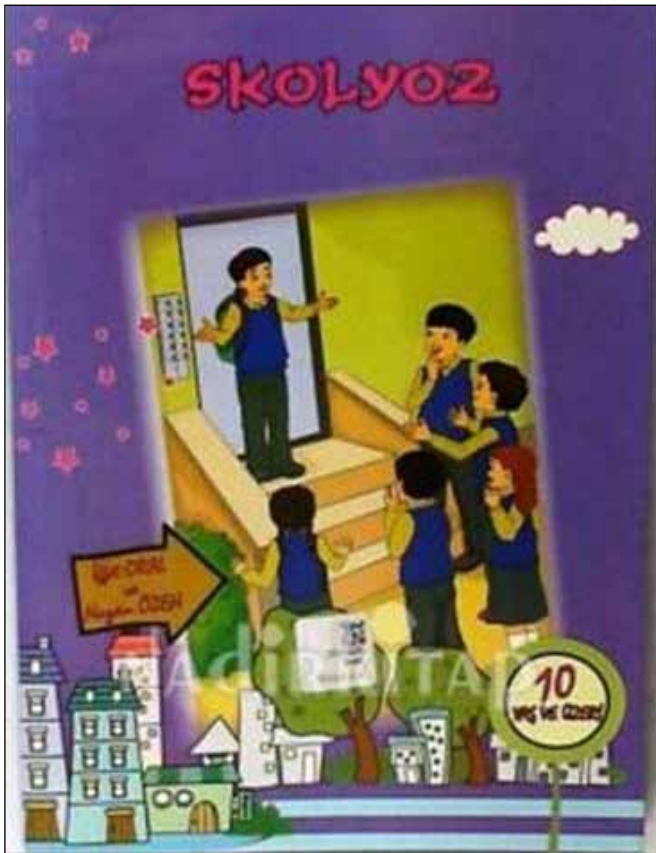


Figure 13: Cover of Children's book written by İffet Oral and Nazan Özen (Scoliosis).

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