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Аналитический обзор 35075 случаев хирургического лечения деформаций конечностей и причины установления инвалидности

The analysis report of surgical treatment of limb deformity and disability: 35,075 cases

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Цель. Изучить характер заболеваемости и стратегию коррекции различных деформаций конечностей ортопедической бригадой Qinsihe за последние 40 лет для представления большой выборки с целью понимания причин, типов и методов лечения деформации конечностей и установления инвалидности у пациентов в Китае. **Материалы и методы**. Всего с мая 1978 г. по декабрь 2018 г. ортопедической бригадой Qinsihe было пролечено 35075 пациентов. Были статистически проанализированы возраст, пол, характер деформации, этиологический и нозологический состав, региональное распределение и хирургические методы лечения пациентов. **Результаты**. Было пролечено 20 458 мужчин и 14 617 женщин в возрасте от 1 года до 82 лет (средний возраст - 20,5 лет). Большинство пациентов были в возрасте от 11 до 25 лет, что составило 19 363 случая (63 %). Проведено 33259 (94,82 %) хирургических вмешательств на нижних конечностях. Географическое представительство пациентов охватывает все провинции, муниципалитеты, находящиеся в непосредственном подчинении центрального правительства, автономные районы Китая и 12 зарубежных стран. Было выявлено 202 этиологических фактора, включая неврологические, наследственные, метаболические, врожденные, сосудистые, лимфоидные, кожные, эндокринные, ятрогенные заболевания и последствия травм. Шесть самых распространенных видов деформаций были связаны с последствиями полиомиелита, церебральным параличом, осложнениями травм, последствиями спондилолиза, варусными и вальгусными деформациями коленного сустава, врожденной эквиноварусной косолапостью. Всего было применено 280 видов хирургических методов, большинство из которых – удлинение ахиллова сухожилия, надмыщелковая остеотомия, артродез подтаранного сустава, тибиофибулярная остеотомия, рассечение метатарзального апоневроза и пластика ахиллова сухожилия длинной малоберцовой мышцей и т.д. Ортопедические операции в сочетании с внешней фиксацией были проведены 8702 пациентам, в том числе фиксатор Илизарова был применен в 3696 случаях и гибридный фиксатор в 5006 случаях. Ортопедическая база данных Qinsihe с 40-летней историей является крупнейшей в Китае базой по лечению деформаций конечностей и установлению инвалидности. Она отражает этиологию, тип, популяционные характеристики, хирургические методы и стратегию установления инвалидности при деформациях конечностей, которые можно лечить с помощью ортопедической хирургии. **Заключение**. Приведенные данные являются бесценным сокровищем для ортопедии и медицины Китая и всего мира, и их важная академическая ценность и историческое значение требуют дальнейшего изучения и в будущем.
Ключевые слова: ортопедия, методика Илизарова, деформация конечности, база данных, анализ

Objective To investigate the incidence characteristics and corrective strategies of various limb deformities treated by Qinsihe orthopaedic team in the past 40 years, so as to provide a large sample for understanding the causes, types and treatment methods of limb deformity and disability in China. **Method** A total of 35,075 cases were treated by Qinsihe orthopaedic team from May 1978 to December 2018. The age, gender, deformity characteristics, etiological and pathological composition, regional distribution and surgical methods of the patients were statistically analyzed. **Results** There were 20,458 males and 14,617 females. The age was 1 year to 82 years old, average 20.5 years. The majority of subjects were from 11 to 25 years old or 19,363 cases (63 %). There were 33,259 cases (94.82 %) of interventions on lower extremity. The geographical distribution of patients covers all the provinces, municipalities directly under the central government, autonomous regions in China and 12 foreign countries. There were 202 etiologies involving neurological, heredity, metabolism, traumatic sequelae, congenital, vascular, lymphoid, skin, endocrine, iatrogenic and so on. The top six deformities were due to poliomyelitis sequelae, cerebral palsy, traumatic sequelae, spondylolysis sequelae, genu varus&valgus, congenital talipes equinovarus. There were 280 kinds of surgical methods, the majority of which were Achilles tendon lengthening, supracondylar osteotomy, subtalar joint arthrodesis, tibiofibular osteotomy, metatarsal aponeurosis and Achilles tendon replacement of peroneal longus muscle, etc. 8,702 cases were treated by orthopedic surgery combined with external fixation, including the Ilizarov fixator in 3,696 cases and hybrid fixator in 5,006 cases. **Conclusion** Qinsihe orthopaedic database with a history of 40 years is the largest one of limb deformity and disability in China. It reflects the etiology, type, population characteristics, surgical methods and strategy of limb disability and deformity, which can be treated by orthopaedic surgery. The data is a great treasure for orthopaedics and disability medicine in China and worldwide, and its important academic value and historical significance need to be further excavated and deep studied in future.
Keywords: orthopedics, Ilizarov technique, limb deformity, data base, analyses

Since 1978 for 40 years, the Qinsihe orthopedic team has operated on 35,075 patients with limb deformity and disability. In order to facilitate retrieval, an electronic database including clinical treatment data and imaging data of patients was established by the end of 2018. The Ilizarov techniques played an important role in the formation of treatment effect and development of this database. The purpose of this study was to analyze the data of this database, and to understand the characteristics, etiology, disease types and current status of limb deformities and disabilities in China and to explain the value of the development of the Ilizarov technique.

DATA AND METHODS

The clinical data of 35,075 patients who underwent surgical treatment from May 25, 1978 to December 31, 2018 were retrospectively analyzed. The gender, age at operation, geographical distribution, etiology and disease composition, deformity characteristics, surgical site and surgical methods of the patients were statistically analyzed. Among them, each patient hospitalized once was recorded as one case, and more than one operation during one hospitalization was still counted as one case; multiple hospitalized operations at different times were recorded as multiple cases.

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The statistical results are divided into subgroups according to the current clinical disciplines, such as neurogenic diseases (central and peripheral), congenital and genetic diseases, infectious diseases (bacteria, viruses), trauma and burns, immune metabolic diseases, tumors, vascular diseases blood diseases, bone and joint cumulative damage and degenerative diseases, muscle diseases, degenerative diseases caused by other rare diseases. The top 20 diseases were summarized and the top 20 methods of lower limb surgeries were statistically analyzed.

RESULTS

Among 35,075 patients, there were 20,458 males (58.33 %) and 14,617 females (41.67 %); the ratio was 1.4:1. The patients were aged from 1 to 82 years, with an average age of 20.5 years old; the patients were mainly 11 to 25 years old, with 19,363 cases, accounting for 63 %; the detailed age distribution was shown in Table 1. The patients came from all provinces, municipalities, autonomous regions and 12 foreign countries except Macao (Tables 2 and 3). 202 etiological diseases were involved, including neurology, genetics, metabolism, traumatic sequelae, congenital, vascular, lymphatic, skin, endocrine and iatrogenic diseases, admitted to more than 10 different departments (Table 4–10). The main diseases include poliomyelitis sequelae and cerebral palsy, trauma sequelae, spina bifida sequelae, genu varus & genu valgus and congenital clubfoot (Table 11).

The number of operations from 1978 to 2018 was shown in Figure 1. The locations of operations were 575 upper limb cases (1.64 %), 33,259 lower limb cases (94.82 %) and 1,242 cases (3.54 %) on neck and spine. According to statistics, a total of 280 kinds of surgical methods were used in the Qinsihe orthopedics in the past 40 years, including tendon / fascia release, tendon transposition, osteotomy, bone lengthening, joint fixation, brace assisted distraction, etc. (Table 12). There were 8,702 cases of orthopedic surgery combined with external fixation, including 3,696 cases of Ilizarov ring external fixation and 5,006 cases of hybrid external fixation.

Table 1

Age distribution

Age (years)	Cases (percentage %)
1~5	1,981 (5.65)
6~10	5,322 (15.17)
11~15	5,975 (17.03)
16~20	7,072 (20.16)
21~25	6,316 (18.01)
26~30	3,978 (11.34)
31~35	2,214 (6.31)
36~40	1,086 (3.10)
41~50	781 (2.23)
51~60	271 (0.77)
61~70	67 (0.19)
71~80	10 (0.03)
>80	2 (0.01)

Table 2

Region distribution of Chinese patients

Region	Cases (n)
Beijing	1,742
Tianjin	156
Shanghai	85
Chongqing	74
Heilongjiang	7,471
Jilin	446
Liaoning	474
Inner Mongolia	496
Hebei	1,632
Shanxi	715
Henan	4,076
Shandong	2,943
Jiangsu	526
Anhui	1,177
Hubei	3,185
Hunan	1,488
Jiangxi	2,664
Zhejiang	560
Fujian	714
Guangdong	541
China Taiwan	1
Hainan	59
Guangxi	122
Guizhou	167
Yunnan	139
Sichuan	331
Shanxi	1,499
Gansu	1,042
Ningxia	84
Qinghai	104
Xinjiang	314
Tibet	27
Hong Kong	1
Total	35,055

Table 3

Cases of foreign patients

Nation	Cases (n)
Russia	5 (operated in Russia)
Indonesia	2
Syria	2
Romania	1
Saudi Arabia	1
Hungary	1
U.S.A	2
Mongolia	2
Vietnam	1
Kazakhstan	1
South Africa	1
Palestine	1
Total	20

Table 4

Case distribution of limb deformity caused by central nervous system disease sequalae

Category	Cases (n)
Sequelae of cerebral palsy	4,670
Sequelae of encephalitis	72
Sequelae of brain trauma	62
Sequelae of hydrocephalus	21
Sequelae of acute myelitis	20
Sequelae of incomplete paraplegia after spinal cord injury	5
sequela of stroke	4
Spastic deformity of foot and ankle caused by drug-induced spinal cord poisoning	3
Sequelae of hepatolenticular degeneration	3
Limb deformity caused by craniopharyngioma	2
Deformity of lower limbs caused by compression of thoracic spinal cord	2
Spinal cord spasmodic lower extremity deformity	2
Sequelae of spinal arachnoiditis	1
Limb deformity of incomplete spinal cord injury caused by ossification of cervical posterior longitudinal ligament	1
Limb deformity in Parkinson's disease	1
Foot deformity after intracranial cyst surgery	1
Sequelae of subarachnoid hemorrhage	1
Epilepsy sequelae	1
Sequelae of cerebral arachnoiditis	1
Total	4,873

Table 5

Case distribution of limb deformity caused by peripheral nervous disease sequalae

Category	Cases (n)
Spina bifida lower limb deformity	910
Scoliosis limb deformity	48
Sequelae of lateral sclerosis	33
Sequelae of obstetric paralysis	21
Sequelae of sciatic nerve injury	16
Limb deformity in ankylosing spondylitis	4
Sequelae of spinal nerve (root) injury	3
Sequelae of radial nerve paralysis	2
Total	1,037

Table 6

Case distribution of limb deformity caused by congenital deformity

Category	Cases (n)
Congenital clubfoot	715
Developmental dysplasia of the hip	542
Congenital multiple joint contracture	134
Congenital fibula hemimelia	100
Congenital pseudarthrosis of tibia	84
Congenital dislocation of patella	55
Congenital coxa varus	48
Congenital shortening of lower extremity	37
Absence of radius	21
Multiple epiphyseal dysplasia	20
Congenital hallux foot deformity	19
Multiple chondrodysplasia	17
Congenital pterygoid knee joint	15
Congenital vertical talus	14
Congenital tibial hemimelia	12
others	116
Total	1,949

Table 7

Case distribution of limb deformity caused by genetic diseases

Category	Cases (n)
Hereditary sensorimotor disease	224
Diaphyseal sequestration	28
Hereditary spastic paraplegia	20
Progressive muscular dystrophy	17
Familial neurofibromatosis	13
Familial cavus	6
Trifunctional protein deficiency	1
Myositis ossificans progressiva	1
Hereditary chondrodysplasia	1
Sequelae of cerebral cavernous degeneration	1
Total	312

Table 8

Case distribution of limb deformity caused by bacterial infection diseases

Category	Cases (n)
Chronic osteomyelitis	95
Sequelae of suppurative arthritis	52
Sequelae of meningitis	35
Sequelae of bone tuberculosis	18
Sequelae of sepsis	7
Sepsis sequelae	3
Sequelae of cerebral tuberculoma	2
Sequelae of transverse myelitis	2
Tetanus sequelae	2
Sequelae of toxic bacillary dysentery	1
Sequelae of typhoid	1
Sequelae of gastrocnemius infection	1
Sequelae of synovial tuberculosis	1
Sequelae of lumbar tuberculosis	1
Sequelae of tuberculous meningitis	1
Sequelae of choroiditis	1
Total	223

Table 9

Case distribution of limb deformity caused by virus and fungal infection

Category	Cases (n)
Sequelae of Poliomyelitis	23,520
Sequelae of Guillain Barre syndrome	83
Sequelae of epidemic encephalitis B	11
Sequelae of hand foot mouth disease	9
Sequelae of mildewed sugarcane poisoning	1
Total	23,624

Table 10

Limb deformity caused by trauma and burn injury

Category	Cases (n)
Post-traumatic stress disorder	917
Sequelae of common peroneal nerve paralysis	64
Developmental deformity of lower limbs caused by epiphyseal injury	42
Bone defect	35
Nonunion	34
Sequelae of burn	29
Sequelae of common peroneal nerve injury	17
Residual deformity of replantation of amputated limb	1
Total	1,139

Table 11

Number of diseases involved (Top 20)

Category	Cases (%)	Age (year, verage)
Sequelae of polio	23,520 (67.06)	1~71 (20.60)
Sequelae of cerebral palsy	4,670 (13.31)	1~63 (13.11)
post-traumatic disorder	918 (2.62)	3~84 (22.41)
Sequelae of spina bifida	910 (2.59)	1~50 (18.25)
Genu varus and genu valgus	724 (2.06)	2~67 (22.21)
Congenital clubfoot	716 (2.04)	1~60 (12.56)
Developmental dislocation of hip	542 (1.55)	1~48 (12.76)
Gluteal muscle contracture lower limb deformity	231 (0.66)	3~42 (14.73)
Limb deformity in sensorimotor neuron disease	224 (0.64)	4~65 (21.74)
arthrogryposis multiplex congenita	134 (0.38)	1~32 (10.93)
Chronic osteomyelitis	95 (0.27)	3~52 (23.21)
Congenital fibular hemiarthroplasty	95 (0.27)	1~40 (11.05)
Congenital pseudarthrosis of tibia	84 (0.24)	2~47 (13.27)
Guillain-Barre Syndrome	83 (0.24)	2~47 (19.80)
Rickets	75 (0.21)	4~53 (19.60)
Sequelae of encephalitis	73 (0.21)	4~39 (16.49)
Iatrogenic limb deformity	70 (0.20)	4~63 (24.56)
Muscular torticollis	66 (0.19)	2~41 (15.78)
Common peroneal nerve palsy limb deformity	64 (0.18)	1~56 (14.87)
Sequelae of brain injury	62 (0.18)	6~49 (21.75)

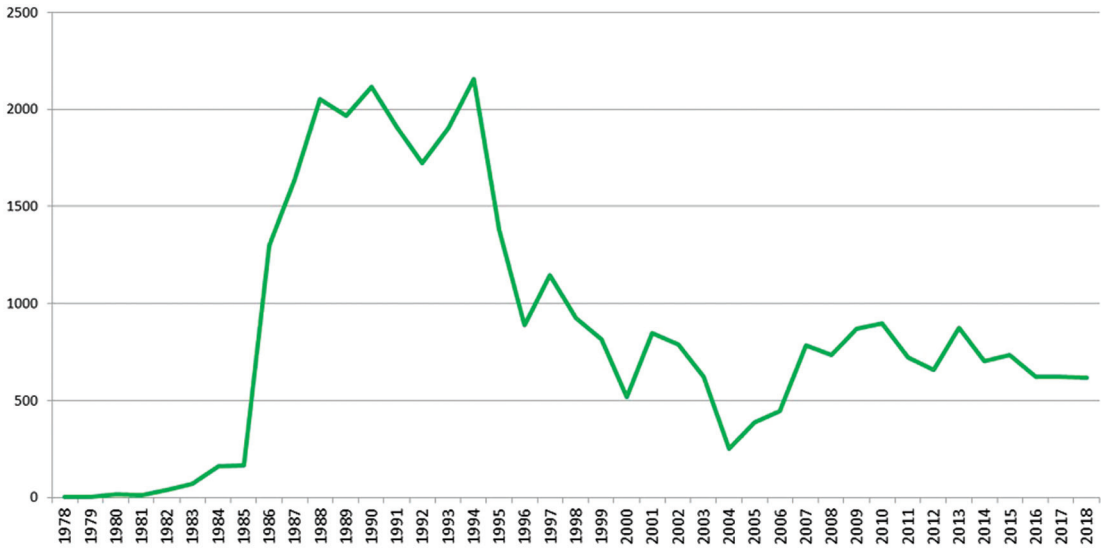

Fig. 1. Surgical cases per year (n)

Table 12

Surgical method used (Top 20)

Category	Cases (n)
Achilles tendon lengthening	7,868
Supracondylar osteotomy of femur	7,356
Calcaneotalar arthrodesis	6,292
Tibiofibular osteotomy	4,167
Release of plantar aponeurosis	3,672
Transposition of peroneus longus to replace Achilles tendon	2,545
Transposition of external oblique abdominis to replace gluteus medius	2,381
Release of hip flexion deformity	2,370
Triple Arthrodesis	2,291
Partial release of adductor femoris at the starting point	1,961
Lengthening of posterior tibial tendon	1,807
Knee flexion release	1,715
Osteotomy of the first metatarsal base	1,397
Distal subcutaneous amputation of gracilis tendon	1,165
Osteotomy and lengthening of tibia and fibula	1,138
Transposition of peroneus brevis to replace Achilles tendon	1,040
Anterior external placement of posterior tibial muscle	1,010
Dissection of common carotid artery adventitia sympathetic network	978
Iliotibial tract release	900
Transposition of sacrospinalis muscle to replace gluteus muscle	885

DISCUSSION

In May 1978, Dr. Qin Sihe successfully carried out his first case of deformity correction of clubfoot in Miaoshan hospital of Laiwu city, Shandong Province, and thus embarked on the road of orthopedics [1]. From the beginning of the implementation of orthopedic surgery, a habit has been formed that all patients who have been treated by him and his team routinely fill in a form before surgery, and every 100 copies can be kept in a file. In the past 40 years, although many units changed, the habit of accumulating the data of cases has never changed. Since 2013, cases collection has been introduced electronically. To December 31, 2018, 35,075 cases have been collected. Among them, 94.82 % were lower limb and ankle deformity correction. Some congenital, hereditary, metabolic and acquired severe complex limb deformities were recorded, and many overseas patients also were attracted for medical treatment. Therefore, the data of limb deformities is a wealth in the medical field, especially for lower limb deformity correction.

Through the preliminary analysis of clinical data of 35,075 patients, the results showed that there were significantly more male patients than female ones, which may be related to China's long-term implementation of Family Planning, rural families pay more attention to boys, and their limb deformity and disability got more opportunities for treatment. The range of age for treatment is wide, but young people prevail, of which 81.71 % are patients aged 6-30. It can be seen that young people with limb deformity, especially lower limb deformity, are the main population receiving orthopedic surgery, which is related to the large amount of exercise, high requirements for participating in social activities, strong requirements for recovering health and improving function. The year period with the largest number of operations was 1988–1994, which was the time when the state implemented Salvage Surgery for Poliomyelitis sequelae. Dr. Qin served as the director of two centers for poliomyelitis sequelae correction in Heilongjiang province and Beijing city, and presided over the operation correction tasks of the two provinces and cities. According to the geographical distribution, there were 7,471 cases of surgical patients from Heilongjiang province, accounting for 21.30 % of all patients. It was related to the fact that Qin had worked in Heilongjiang province for 5 years and carried out a large number of surgeries.

More than 10 disciplines were covered in this group of limb deformities and disabilities, including gynecology, pediatrics, nerve, blood, tumor, skin, immunity, etc., covering almost all sub-disciplines of orthopedics with 202 diseases. It was difficult to determine the etiology in some limb deformities. The top six deformities were poliomyelitis sequelae, cerebral palsy, trauma sequelae, spina bifida sequelae, genu varus, genu valgus, congenital clubfoot, which reflected the incidence of the main diseases of lower limb deformity to a certain extent. In the disease spectrum, the sequelae of poliomyelitis have been gradually replaced by cerebral palsy, traumatic limb deformity and lower limb deformity due to spina bifida.

There were 280 kinds of surgical methods, including tendon/fascia release, tendon transposition osteotomy, bone lengthening, joint fixation, bone traction, brace assisted stretching, etc. The most commonly used operations include Achilles tendon lengthening, supracondylar osteotomy of femur, calcaneal talar joint fusion, tibiofibular osteotomy, plantar aponeurosis release and peroneal longus tendon replacement. The most common causes were ankle deformity and sequelae of poliomyelitis [2, 3].

The combination of Ilizarov technology and these operations was a revolution in the history of orthopedic surgery, which greatly improved the surgical safety and clinical treatment effect [4–6]. Among them, osteogenesis imperfecta, scleroderma, congenital tibial hemimelia and other diseases were all managed with external fixators.

Most patients with these diseases refuse amputation and always seek medical treatment. The successful application of the Ilizarov technology shows that the techniques and the concept of external fixation played an irreplaceable role in the management of complex deformities.

Based on Chinese culture, Qin orthopedic team has been continuously exploring, practicing and summarizing the surgical experience in the management of limb deformities and disabilities. Based on the research and application of the Ilizarov technology, the team has put forward and practiced the "Natural reconstruction orthopedics [7]" and the principle of "One walk, Two lines and Three balances", which in turn guide the clinical practice in orthopedics and form a new model to establish orthopedic technology theory system with distinctive characteristics. It emphasizes the static balance and the dynamic balance in treatment and rehabilitation. It is able to cure severe and complex limb deformities with relatively simple means of diagnosis and treatment. It enables hundreds of patients with limb deformities who crawl, squat or rely on wheelchairs to walk upright, and cures a number of limb deformities on the verge of amputation.

The preliminary statistical results of 35,075 cases of limb deformities reflect the etiology, disease types, population characteristics and surgical methods used for limb deformities at present. These data with great academic value and historical significance for limb reconstruction are a treasure house of orthopedics for China and the world.

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