



History and Formation of “Limb Lengthening and Reconstruction Surgery – LLRS” as a Subspecialty of Orthopedic Surgery

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Abstract

In 1998, the first meeting of members of the Association for the Study and Application of the Methods of Ilizarov (ASAMI) was held in the USA to introduce and popularize the methods developed in Kurgan by Professor G. Ilizarov and his staff. During 2005-2016, other communities worked in parallel with ASAMI, which went beyond the use of only the Ilizarov apparatus. Since 2017, the joint meetings have been called “Combined congress of the ASAMI-BR and ILLRS societies”. This actually became the basis for the definition of “Limb Lengthening and Reconstruction Surgery (LLRS)” as a subspecialty of orthopedic surgery that treats patients with nonunions, congenital and acquired long bone, large joints deformities of the upper and lower extremities. LLRS is based on the Ilizarov method and discovery (“Ilizarov effect”) with the rational use of external and internal fixation, osteotomy and soft tissue procedures. It takes at least three years for an orthopedic surgeon to become a specialist in the field of LLRS, and the education must be staged. A significant role in this is played by the ASAMI-BR & ILLRS congresses, ExFix & LLRS courses held in many countries, ExFix modules integrated into courses provided as part of the education of AO Trauma, as well as extensive world literature.

Keywords: external fixation, transosseous osteosynthesis, limb lengthening and reconstruction surgery, Ilizarov method, subspecialty of traumatology and orthopedics, training.

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История и становление субспециальности травматологии и ортопедии «Удлинение и реконструкции конечностей»

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Реферат

В 1998 г. в США была проведена первая встреча членов Ассоциации по изучению и применению метода Илизарова — Association for the Study and Application of the Methods of Ilizarov (ASAMI) для внедрения и популяризации методов, разработанных в г. Кургане профессором Г.А. Илизаровым и его сотрудниками. На протяжении 2005–2016 гг. параллельно с ASAMI работали другие сообщества, которые выходили за рамки использования только аппарата Илизарова. С 2017 г. объединенные встречи получили название “Combined congress of the ASAMI-BR and ILLRS societies” — «Объединенный конгресс обществ ASAMI, костных реконструкций и удлинения и реконструкции конечностей». Это фактически стало основой для определения “Limb Lengthening and Reconstruction Surgery (LLRS)” как субспециальности травматологии и ортопедии, занимающейся лечением пациентов с ложными суставами, врожденными и приобретенными деформациями длинных костей, крупных суставов верхних и нижних конечностей. Удлинение конечностей и реконструктивная хирургия базируются на методе и открытии (эффекте) Илизарова с рациональным использованием внешней и внутренней фиксации, остеотомии и операций на мягких тканях. Для того чтобы травматолог-ортопед стал специалистом в области LLRS, требуется не менее трех лет, и образование должно быть ступенчатым. Значимую роль в этом имеют конгрессы ASAMI-BR & ILLRS, курсы по внешней фиксации (ExFix) & LLRS, проводимые во многих странах, ExFix модули, интегрированные в курсы, проводимые в рамках образования АО Trauma, а также обширная мировая литература.

Ключевые слова: внешняя фиксация, чрескостный остеосинтез, удлинение и реконструкция конечности, метод Илизарова, субспециальность травматологии и ортопедии, обучение.

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SOME HISTORY: INTERNATIONAL EXTERNAL FIXATION SOCIETIES

In the late 1970s, Italian orthopedic surgeons learned about the Ilizarov method from patients who returned to Italy after being treated for serious road traffic injuries sustained while vacationing in nearby Yugoslavia. Likewise, Carlo Mauri, a famous Italian explorer and writer went to the USSR, to the Siberian city of Kurgan to be personally treated by Dr. Ilizarov for an infected nonunion of his tibia. Mauri's return to his native land after a successful cure stimulated interest among Italian doctors.

In 1981, the city of Milan, Italy, had a Communist party mayor who arranged for a group of Italian surgeons to travel to the Soviet Union to visit and learn from Prof. Ilizarov. Shortly thereafter, these surgeons began applying distraction osteogenesis principles in their own clinics. Five years later, the Italians presented their preliminary results at international conferences, stimulating the worldwide interest in the Ilizarov method.

In 1986, a Canadian orthopedic surgeon Dror Paley joined a group of Italians going on a journey

to Siberia, becoming the first North American to visit the Institute of G. Ilizarov in Kurgan. A year later, Dr. Stuart Green, a Professor of orthopedic surgery at the University of California, Irvine, became the first American to do so.

In 1987, the first English-speaking workshop was held in Kurgan. Many others have followed. In countries far and wide, surgeons interested in limb lengthening and deformity correction soon formed societies to provide a forum for the dissemination and interchange of ideas about the Ilizarov methods. The first of these groups formed, naturally enough, in Italy. The associations were typically named the Association for the Study and Application of the Methods of Ilizarov (ASAMI).

In 1996, in Amsterdam (Netherlands), at the SICOT congress, an organizational meeting of ASAMI representatives from Italy, India, Netherlands, France, the USA, Russia and other countries took place to create "ASAMI international". In 1998, the 1st ASAMI Congress was held in the USA (Figure 1). Subsequent ASAMI Int. congresses were conducted in Italy (2001), Turkey (2004) and many other countries (Table 1).



Figure 1. 1st ASAMI Congress in 1998 (photo by Prof. G. Dyachkova)

Table 1

International External Fixation and Limb Lengthening and Reconstruction Surgery meetings

Year	ASAMI-based meetings	LLRS-based meetings
1998	1 st ASAMI Meeting (USA)	
2001	2 nd ASAMI Meeting (Italy)	
2004	3 rd ASAMI Meeting (Turkey)	
2005		1 st World Congress of External Fixation (Peru)
2006	4 th ASAMI Meeting (Japan)	
2007		2 nd World Congress of External Fixation (Egypt)
2008	5 th ASAMI Meeting (Russia)	
2010	6 th ASAMI Meeting (Egypt)	1 st International Congress of External Fixation & Bone Reconstruction, 6 th Meeting of the ASAMI International & 3 rd World Congress of External Fixation (Spain)
2012	7 th ASAMI & BR Congress Meeting (Greece)	2 nd World Congress of External Fixation and Bone Reconstruction (Brazil)
2014	8 th International ASAMI Conference (India)	
2015		1 st Combined Meeting of ASAMI-BR and ILLRS (USA)
2016		2 nd Combined Meeting of ASAMI-BR and ILLRS (Australia)
2017	3 rd World Ortho Recon ILLRS&ASAMI Congress, 3 rd Combined Meeting of ASAMI-BR and ILLRS (Portugal)	
2019	4 th Combined Congress of the ASAMI-BR and ILLRS societies (UK)	
2022	5 th Combined Congress of the ASAMI-BR and ILLRS societies (Mexico)	
2024	6 th Combined Congress of the ASAMI-BR and ILLRS societies (China)	
2026	7 th Combined Congress of the ASAMI-BR and ILLRS societies (Malaysia) (planned)	

At the same time, D. Paley and S. Green formed ASAMI-North America, which eventually changed its name to the Limb Lengthening and Reconstruction Society – North America (LLRS-NA), aiming to emphasize the more universal nature of the group’s focus, moving beyond the Ilizarov method and apparatus. However, proponents of the Hoffmann-style of external fixation continued to defend their preferences.

Therefore, the “Ilizarov” and “Hoffmann” groups held competing meetings until 2017.

In 2017, a meeting with a remarkable name “3rd World Ortho ReCon ILLRS & ASAMI Congress” was held in Portugal. There, by direct voting of the meeting participants, the type of organization, its name and its charter were approved (Figure 2). Thereafter, joint meetings were held and planned.



Figure 2. Choice of the type and general name of the organization at the Congress in Portugal, 2017

“EXFIX & LLRS” – A SUSTAINABLE BRAND

External Fixation (ExFix) is a method for stabilization or manipulation of bone, joint, and soft tissue using smooth or threaded pins and wires that traverse the soft tissue envelope and are linked by external frame components. Limb Lengthening and Reconstruction Surgery (LLRS) is a subspecialty of traumatology and orthopedics responsible for the treatment of patients with congenital and acquired nonunions, defects, deformities of long bones and large joints in relationship with soft tissues. LLRS is based in part on the Ilizarov method and discovery (“effect”) with the rational use of external and internal fixation, osteotomies, and operations on soft tissues.

Modern external fixation can be used for temporary, definitive, and integrated external-internal fixation treatment (Figure 3). In the first case, it is used as an assisting external fixation for nailing and plating. Temporary ExFix is also used in sequential osteosynthesis, for example, in case of emergency trauma to stabilize bone fragments until the condition of the patient and soft tissues allows for final internal fixation. Another example of sequential osteosynthesis: gradual deformity correction using external fixation techniques, and then changing to internal fixation. As a

temporary remedy, external fixation is used in integrated (combined) treatment methods: in lengthening over the nail (or along a plate) and in bone transport over the nail (along the plate). Accordingly, “definitive external fixation” can be used as the main and only method of treatment. It should be noted that the frequency of using definitive external fixation, in comparison with temporary and integrated, has decreased lately.

This classification of modern external fixation allows us to determine the vector by which specialists should be trained for limb lengthening and reconstructive surgery. Undoubtedly, any orthopedic surgeon must be able to correctly apply a stabilizing frame when treating severe concomitant injuries, multiple fractures and/or providing optimal conditions for soft tissue healing. In addition, any orthopedic surgeon must be able to understand modern deformity analysis and use knowledge related to reference lines and angles (RLA): anatomical, mechanical axes, joint lines and features of their intersection. Only this knowledge is an objective basis for assessing the quality of fracture reduction. The orthopedic surgeon using RLAs will be critical of the ability to perform “standardized” osteotomies (such as high tibial osteotomy – HTO) and will favor individualized planning and outcome evaluation.

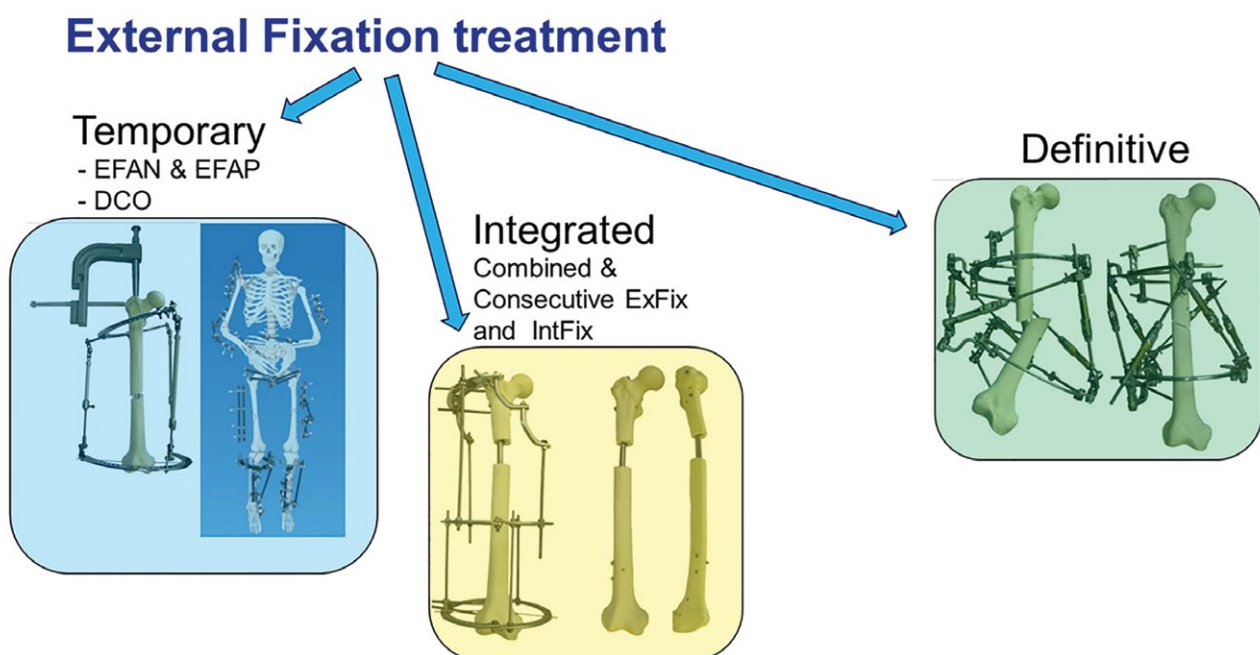


Figure 3. Types of treatment that use external fixation

For those orthopedic surgeons who aim to work in the field of LLRS, special training is required. This is to develop skills for the treatment of patients with complex fractures, congenital and post-traumatic problems including those in joints, deformities and defects of long bones, the pelvis and foot, as well as for restoring function and range of movement in some large joints. Often, it is the case that the underlying pathology is complicated by the presence of compromised bone and soft tissues – after numerous previous operations or the presence of chronic infection. The peculiarities of limb lengthening and reconstruction in children and adolescents, elderly and senile patients require special mention. To be able to treat the extensive pathology, it is necessary to have the skills to use external fixation, internal fixation, combined and sequential ExFix and IntFix techniques, internal distractors, and also to perform osteoplastic and soft tissue surgeries (Figure 4).

Is there a need for orthopedic surgeons specializing in external fixation, limb lengthening and reconstruction? Based on the study (enrolled 17 physicians) it was found that for a city like St. Petersburg with a population of more than 5 million people, the number of patients for

definitive external fixation reaches 1.6% of the total number of orthopedic operations, i.e., at least 300 cases per year*.

How long does it take to become a trained ExFix & LLRS orthopedic surgeon? According to the leading experts working in this field – up to 3 years (data from a survey in which V. Shevtsov, G. Dyachkova, S. Green, D. Paley, J. Herzenberg, R. Rozbruch, N. Lopes, J. Bongiovanni took part). At the same time, ExFix & LLRS training should be stepwise and, by analogy with the AO Foundation educational programs, include basic, advanced and master levels of courses.

Where can an orthopedic surgeon receive this type of education? The remit of organizations such as the ASAMI-BR and ILLRS societies do not include organizing routine educational courses. The collaborative meetings of these societies, which take place every 2 years, allow the participants to learn about the LLRS at a level corresponding to the day of the meeting and also to take part in masterclasses and workshops. There are affiliated “Journal of Limb Lengthening and Reconstruction Surgery” (<https://journals.lww.com/JLLR/pages/default.aspx>) and “Genij Ortopedii – Genius of Orthopedics” (<https://www.ilizarov-journal.com/jour>).

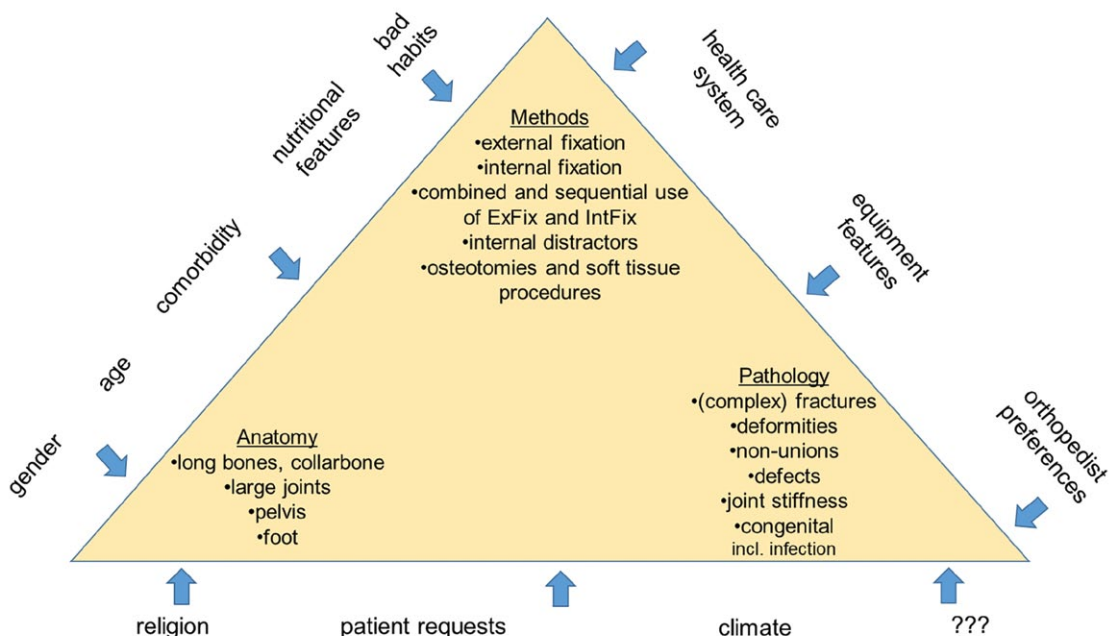


Figure 4. LLRS “pyramid”

* Solomin L.N., Vorontsova T.N., Tiuliayev N.V., Lebedkov I.V. Use of transosseous osteosynthesis method in a city: the present and prospects. Genij Ortopedii. 2012. № 2. P. 82-88.

In 2015, in St. Petersburg (Russia) the first ever AO/OTA master course on ring external fixation was held. Subsequently, AO Trauma-based external fixation courses became an annual event. An AO ExFix working group was created to develop a unified terminology and took an active part in organizing and conducting ExFix courses and modules that were integrated into various educational courses of AO Trauma. However, according to the conditions stipulated by the AO Trauma group, ExFix courses should only be at the “Master” level. Consequently, the two-day programs span modules from several levels and encompass, for example, fractures, deformities, defects, contractures, etc. At the same time, in the Basic and Advanced AO Trauma courses, modules devoted to the basics of ExFix are not sufficiently well developed and do not cover terminology, classifications, basic biomechanics and frame application techniques adequately. Therefore, until now, the AO ExFix courses have been largely introductory in nature.

This lack of a structure for training specialists in the field of ExFix & LLRS is compensated for by the presence of training units at universities, research centers, and large hospitals. The most famous of them are localized in the USA (Baltimore, Miami, New York, Texas), Italy (Lecco, Milan, Como), England (Liverpool, London), Spain (Lisbon), Japan (Tokyo, Kanazawa), Brazil (San Paolo, Belo Horizonte), Colombia (Cali, Midelin), Egypt (Cairo), India (Solapur, Gorakhpur, Bengaluru), Bangladesh (Dhaka), Russia (Kurgan, St. Petersburg). Some contribution is made by the industry-sponsored courses, i.e., supported by companies producing orthopedic hardware, but

the learning is often directed to using a specific device or implant rather than the variety of skills needed for the clinical problem at hand.

To date, a wide library of textbooks and manuals on ExFix & LLRS has been published around the world. A list of main publications is given below in the list of recommended literature.

CONCLUSIONS

It will soon be 200 years since surgeons have begun using external fixation in the treatment of fractures, their consequences and orthopedic pathology. A huge development path has been passed from the first “pin-less” Malgaigne apparatus to software-based frames and internal distractors. A whole era in the development of transosseous osteosynthesis is associated with the name of Gavriil Ilizarov. The main achievement of G. Ilizarov is not only an original ring external fixation device, but also the discovery of the biologic capacity of tissue to form under appropriate conditions of distraction and stabilization (Ilizarov effect). The creation of an organization like ASAMI is an unprecedented event in the history of Russian traumatology and orthopedics and its pride. Having gone through the stages of formation and development, the Combined Congress of the ASAMI-BR and LLRS societies are now held every 2 years. Limb lengthening and reconstruction surgery is considered as a subspecialty of traumatology and orthopedics. An increase in demand for such specialists can be confidently predicted due to the annual increase in the number of patients requiring treatment for congenital pathology and the consequences of injuries, including combat ones.

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