

## Preface

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“Функция, функция, функция”

This was how Prof. G.A. Ilizarov answered my question, “What is the most important way to insure success with the Ilizarov Method?”

His response—repeating the word “function” 3 times—caught me by surprise. I expected a discourse on preoperative planning or perhaps tensioned-wire technique. Likewise, at the operating table in Russia, Ilizarov typically emphasized the need for a gentle, “sparing” corticotomy, preserving both the periosteal and intramedullary blood supply. So why didn’t he repeat his oft-told tales?

The Professor had just finished reviewing my first dozen circular fixator cases at Rancho Los Amigos Medical Center in Downey California, where he noticed tardy regenerate ossification in several patients. He wanted to stress the importance of functional limb use while still in a frame, thereby encouraging newly-formed bone to mature. For lower extremity applications, this meant gradually increased weight-bearing, whereas, for upper limb applications, functional use demanded self-grooming, eating, dressing, and so forth. Without these activities, the regenerate bone would never be strong enough to allow frame removal. It was an important lesson for me.

By then, I already had considerable experience with problems associated with external skeletal fixators, especially the Hoffmann System that I used for septic and sterile non-unions and malunions of long bones. Indeed, 6 years before Ilizarov’s visit, I concluded my *Complications of External Skeletal Fixation* (1981) with the following lines:

*Complications continue to haunt external fixation in spite of the superbly designed frames and components currently available. ... Hopefully, the decade of the 1980s will more clearly delineate the rightful place of external skeletal fixation in the armamentarium of the orthopedic surgeon.*

My goal was to increase the safe application of external fixators, mindful of the numerous complications, especially pin tract infections, associated with their use.

In my wildest dreams, I couldn’t have imagined that half a decade after writing those words, Aeroflot would deposit me in a distant Soviet city to study the Methods of Ilizarov, which expanded clinical applications of external skeletal fixation beyond anything heretofore conceivable. Now, for the first time, crippling birth anomalies became amenable to curative treatment, surgeons could eliminate skeletal defects regardless of their length, and post-trauma long bone deformities responded to minimally invasive surgical interventions.

All of these treatment strategies, moreover, involved external skeletal fixation; at first, Ilizarov’s tensioned-wire circular apparatus, and later, either Taylor’s hexapod Spatial Frame or a variety of stiff monolateral fixators.

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Nevertheless, complications still plagued Ilizarov fixators and competing frames, as with simpler designs. In fact, bone fragment movement within the frames, although slow and controlled, increased discomfort and transcutaneous implant sepsis significantly, when compared with applications involving stationary bone fragments.

For this reason, innovative surgeons sought ways to utilize Ilizarov’s distraction osteogenesis without the burden of a bulky, painful fixator appended to a limb in treatment. The most obvious choice: expandable intramedullary nails. The earliest such implants lengthened via irreversible ratchet mechanisms; they proved difficult to control. Next came electrical and magnetic motors, powered by external sources, a far more satisfactory design. Indeed, these latter devices continue to dominate the market today.

Through a combination of geography and serendipity, I joined the team that created today’s most widely used magnetically controlled IM lengthening nail, remaining actively involved in ongoing developments. Thus did my looming retirement get pushed to a back burner and I entered one of the most remarkable phases of my life.

At first, we limited expandable nails to straightforward long bone lengthening, but their ease of use by surgeons, combined with the astonishing acceptance by patients, surprised even the most skeptical frame-minded Ilizarovians. Concerns about suboptimal regenerate formation (due to marrow canal reaming) proved unfounded. In fact, the dramatic pain reduction with IM lengthening permitted greater functional activity by our patients that, if anything, *accelerated* regenerate maturation.

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Pioneering surgeons soon moved beyond simple limb lengthen equalization to try self-lengthening implants on a variety of other pathologies. Hence, the list of conditions treatable with a telescopic implant began to elongate faster than a runaway nail!

Industry followed suit: Biomedical engineers developed implants to meet a variety of needs. The newer devices included extra-short implants for stature surgery in dwarfs; super-strong nails for early weight-bearing; bone transport nails; and self-lengthening plates for pediatric cases.

This issue of *Techniques in Orthopedics* contains preliminary reports on several of the aforementioned treatment options. Some, it appears, do better than others. For as we attempt to cure ever more challenging conditions with motorized implants, we may eventually hit a membrane ceiling: the stripped-off periosteum. We’re already seeing docking site issues with intramedullary bone transport.

As surgeons begin to use lengthening nails to correct complex angulation-translation-rotation deformities, the operative exposure needed to align the fragment canals may exceed the biological capacity to heal. We must thus proceed cautiously, following one series to completion before commencing another, more demanding one.

The array of conditions that yield to Ilizarov’s treatment strategies boggles the mind. The principle drawback to his method of distraction osteogenesis by the gradual movement of

osseous tissue was the need for a multiplanar external fixator, with all its problems. Nevertheless, fixators will continue to occupy a place in acute trauma care and the management of, particularly complex problems. With limb lengthening,

however, we are living through what evolutionary biologists call an “extinction event”—a cataclysmic change in the technical landscape of our profession. It is an honor to be part of the process.