

REHABILITATION OF CHILDREN WITH LESIONS OF THE PROXIMAL HUMERAL METAEPIPHYSIS USING TRANSOSSEOUS DISTRACTION OSTEOSYNTHESIS TECHNIQUES

Garkavenko Y.E.^{1,2}, Lamerdonov A.A.², Dolgiev B.H.²

¹ The Turner Institute for Children's Orthopedics, Saint-Petersburg, Russian Federation

² North-Western State Medical University n. a. I. I. Mechnikov, Saint-Petersburg, Russian Federation

We present an analysis of the treatment of 39 children with a shortening of the humerus after sustained osteomyelitis. Variants of lesions of the proximal humerus metaepiphysis are highlighted, and the differentiated approach to therapeutic measures depending on the identified changes resulted in a positive outcome.

Keywords: children, sequelae of osteomyelitis, humerus lengthening.

Introduction

Humeral growth is ensured by the proximal metaepiphyseal growth plate in 80% of cases. A lesion observed after previous hematogenous osteomyelitis, in which there are various degrees of hypofunction as well as segmental or total destruction, not only induces significant shortening of the affected segment and formation of a cosmetic defect but also supports the development of metaepiphyseal deformations and shoulder joint dysfunction [1-6]. However, patients seldom seek treatment even with significant degrees of shoulder shortening. This fact can be explained by the significant adaptability of the upper limb, which satisfies functional needs of children during a long interval.

There have been few reports based on sufficient clinical materials and reflecting treatment efficacy in patients with sequelae of hematogenous osteomyelitis of the proximal humeral metaepiphysis [1, 2]. In the non-Russian literature, data on humeral lengthening are presented but only as single observations in which approaches of shoulder shortening after a previous inflammatory process are described [3-12]. However, the problems of differential approaches to treatment of children with this pathology, with consideration for the types of shoulder lesion, have been insufficiently reported, thus prompting this study.

Materials and methods

We treated 39 children (20 boys and 19 girls, 7–17 years old) with a lesion of the proximal humeral metaepiphysis and shoulder shortening at “NIDOI by G.I. Turner” from 2004 to 2014. Of the children, 19 (48.7%), 18 (46.2%), and 2 (5.1%) had right, left, and bilateral humeral lesions, respectively. All children seek treatment at shoulder shortening from 6 to 11 cm. The deficit of initial length of the affected segment was from 21.4% to 56.5% (mean 38.5%). A complex physical examination, including clinical, roentgenological, and physiological (electromyography and rheovasography) diagnostic techniques, was performed to evaluate the anatomical and functional condition of the upper limb.

Results and discussion

Patients with a lesion of the proximal humeral metaepiphysis were comprehensively examined to define the symptoms of shoulder joint lesions occurring after previous hematogenous osteomyelitis. These symptoms included shoulder shortening associated with cicatricial changes of shoulder soft tissues and hypotrophy of shoulder and forearm soft tissues; shoulder joint dysfunction with predominant restriction of shoulder retraction; abnormality of the capitellum with dystrophic cartilaginous and osseous tissues manifesting at different

rates; predominant absence of humeral diaphyseal abnormalities; and segmental or total hypofunction or destruction of the proximal humeral metaepiphyseal growth plate associated with moderately decreased blood flow level and functional status of muscles of the affected limb segment.

The reconstruction of shoulder length and improvement of shoulder joint function are reported based on rehabilitation actions in children with a lesion of the proximal humeral metaepiphysis. The surgical indication was shoulder shortening of 6 cm or more as well as restriction of shoulder retraction caused by a varus deformity of the proximal humeral metaepiphysis at an angle less than 90°. Shoulder shortening was diagnosed when children began to compensate for the deficit in length by means of distortion of posture in the frontal plane and shoulder retraction of less than 90°, which significantly damaged functionality of the affected upper limb.

Two patient groups were defined for which the therapeutic approach depended on initial anatomic and functional status of the affected upper limb segment. Group 1 consisted of 23 patients (59%) who had all symptoms of a shoulder joint lesion associated with moderate restriction in function (Fig. 1). Group 2 included 16 patients (31%) with frank restriction of shoulder retraction associated with its shortening. The aforementioned dysfunctions occurred at a different manifestation rate of varus deformation of the proximal metaepiphysis of the affected bone (Fig. 2).

The pin/wire or monolateral rod external fixators were applied on shoulders of patients in group 1 for the purpose of length reconstruction of the affected upper limb segment. For fixation, two threaded rods were inserted into the proximal and distal humeral metaphysis from the outer surface, which were fixed in two semi-ring supports of the Ilizarov apparatus at rod arrangement or three wires were led via the distal third of the humerus at pin/wire arrangement of the apparatus. The osteotomy was performed via an external approach in the upper third of the shoulder. The shoulder was lengthened by 0.25 mm four times/day beginning from 6 days post-surgery up to achievement of the intended result.

The arrangement of the distraction apparatus for group 2 patients was no different from that in group 1, except for modification of insertion of

two proximal threaded rods. They were inserted in the humerus while taking into account the deformation angle of the proximal metaphysis. The apparatus was stabilized after osteotomy and correction of humeral deformation. The retraction amplitude of the surgically operated shoulder was increased by the value of deformation correction. The shoulder length was adjusted by 0.25 mm four times/day beginning from 6 days post-surgery until achievement of the intended result. In two patients with bilateral shoulder shortening, the deformation was corrected by subsequent leveling of lengths of the upper limb proximal segments by means of lengthening one segment by not more than 2 cm.

We did not perform bilocal osteotomy with deformation correction of the upper third of the humerus and lengthening of the midshaft, as has been reported by some authors [2, 10], because of the increasing risk of surgical injury and risk of a lesion of the peripheral nerve trunks.

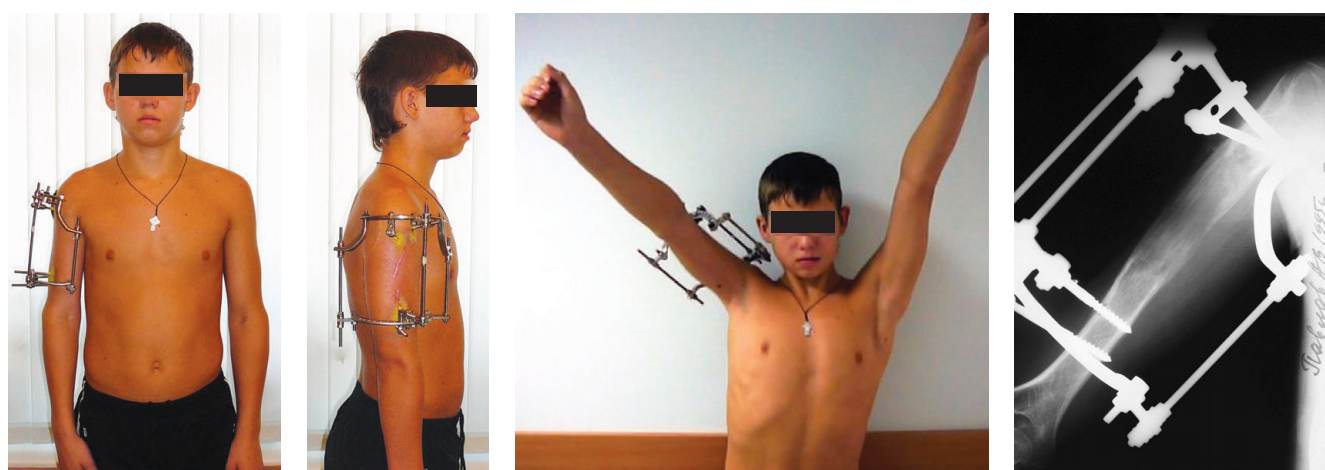
On examination, there was no significant difference in the duration and quality of the distraction graft between groups 1 and 2. The graft formation duration did not statistically differ from the average duration but depended on the value of shoulder lengthening in advanced stages. The shoulder lengthening was 7–12 cm at an average duration of shoulder fixation in the apparatus of 11.2 days/cm of lengthening in group 1. The average duration of shoulder fixation in the apparatus was 16.4 days/cm at a shoulder lengthening of 6–10 cm in group 2.

In contrast to other reports [1, 3, 8, 9], we did not observe any sequelae associated with disorders of shoulder joint stability or formation of shoulder deformities on the side of the lesion resulting from shoulder lengthening. We did note neuropathies of peripheral nerves in four (10.3%) children, which stopped after conservative therapy. In one case, breakage of the proximal threaded rods did not require additional surgery, and parts of the threaded rod were extracted when the rod apparatus was removed from the shoulder. The ORTHO-SUV apparatus, which is based on passive computer navigation, was used to eliminate distraction graft deformation in one case.

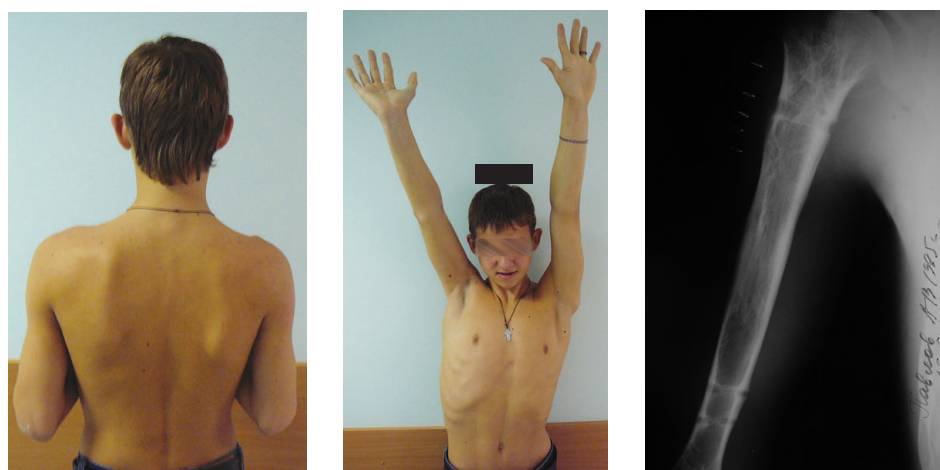
A total of 27 (69.2%) patients were followed long term (from 1 to 10 years). The values of lengthening and shoulder retraction amplitude that were achieved remained in all children. This



A

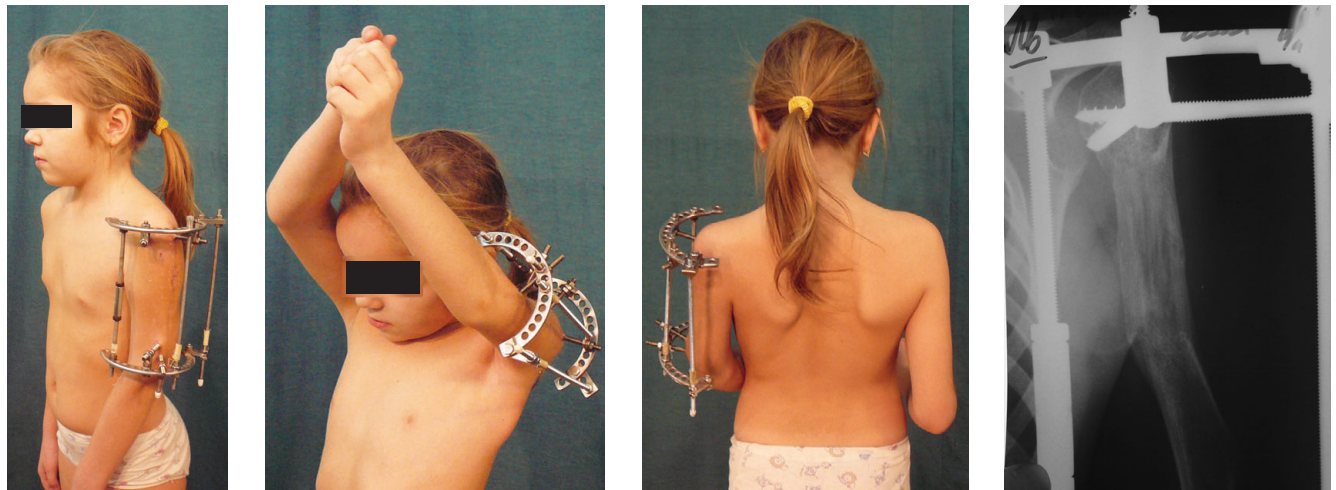


B



C

Fig. 1. Clinical photograph and X-rays of a male patient with hematogenous osteomyelitis of the proximal metaepiphysis of the right humerus (shoulder shortening to 9 cm): (A) before treatment; (B) during treatment; (C) result at 1 year of follow-up. Patient has adequate range of motion of the right shoulder



A



B

Fig. 2. Clinical photograph and X-rays of a female patient with hematogenous osteomyelitis of the proximal metaepiphysis of the left humerus (varus deformation, shoulder shortening to 9 cm). (A) Before treatment; (B) result at 5 years of follow-up. Patient has stable restricted range of motion

finding demonstrates an optimal approach to the reconstruction of shoulder length as well as improving and saving functions of the shoulder joint after hematogenous osteomyelitis in children with various manifestation rates of deformation of the proximal humeral metaepiphysis.

Conclusions

The shoulder shortening after previous hematogenous osteomyelitis is accompanied by various manifestation rates of deformations of the proximal humeral metaepiphysis. The length reconstruction of the affected shoulder should be performed taking into account the manifestation rate of humeral deformations and shoulder joint function disorders. The optimal approaches, using techniques of transosseous distraction osteosynthesis, to resolve shoulder length reconstruction and improve shoulder joint function ensure a positive intended result during long-term observations.

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РЕАБИЛИТАЦИЯ ДЕТЕЙ С ПОРАЖЕНИЕМ ПРОКСИМАЛЬНОГО МЕТАЭПИФИЗА ПЛЕЧЕВОЙ КОСТИ С ИСПОЛЬЗОВАНИЕМ МЕТОДИК ЧРЕСКОСТНОГО ДИСТРАКЦИОННОГО ОСТЕОСИНТЕЗА

© Гаркавенко Ю.Е.^{1,2}, Ламердонов А.А.², Долгиев Б.Х.²

¹ ФГБУ «НИДОИ им. Г. И. Турнера» Минздрава России, Санкт-Петербург

² ГБОУ ВПО «СЗГМУ им. И. И. Мечникова» Минздрава России, Санкт-Петербург

Представлен анализ лечения 39 детей с укорочением плеча после перенесенного гематогенного остеомиелита, выделены варианты поражения проксимального метаэпифиза плечевой кости, отмечен положительный результат дифференцированного подхода к лечебным мероприятиям в зависимости от выявленных изменений.

Ключевые слова: дети, последствия гематогенного остеомиелита, удлинение плеча.

Information about the authors

Garkavenko Yuriy Evgenievich — MD, PhD, professor of the Department of pediatric traumatology and orthopedics. North-Western State Medical University n. a. I. I. Mechnikov, leading research associate of the department of bone pathology of The Turner Scientific and Research Institute for Children's Orthopedics. E-mail: yurijgarkavenko@mail.ru.

Lamerdonov Alim Albiyanovich — MD, resident of the Department of pediatric traumatology and orthopedics. North-Western State Medical University n. a. I. I. Mechnikov.

Dolgiev Bagaudin Khavashevich — MD, PhD student of the Department of pediatric traumatology and orthopedics. North-Western State Medical University n. a. I. I. Mechnikov.

Гаркавенко Юрий Евгеньевич — д. м. н., профессор кафедры детской травматологии и ортопедии ГБОУ ВПО «СЗГМУ им. И. И. Мечникова» Минздрава России, ведущий научный сотрудник отделения костной патологии ФГБУ «НИДОИ им. Г. И. Турнера» Минздрава России. E-mail: yurijgarkavenko@mail.ru.

Ламердонов Алим Альбиянович — клинический ординатор кафедры детской травматологии и ортопедии ГБОУ ВПО «СЗГМУ им. И. И. Мечникова» Минздрава России.

Долгиев Багаудин Хавашевич — аспирант кафедры детской травматологии и ортопедии ГБОУ ВПО «СЗГМУ им. И. И. Мечникова» Минздрава России.