

Bioretec Research and Development

Physeal Fractures and Bioabsorbable Implants

Literature review

Please note, that the effect of ActivaPin™ upon the healing of the growth plate has not been tested in clinical studies, but successful use of the other bioabsorbable implants in physeal fractures has been reported. This document is a literature review on this subject.

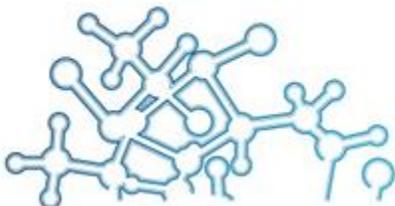
Fixation of physeal fractures with small-diameter bioabsorbable devices are presented successfully in the following indication [1]:

- fracture of the lateral humeral condyle
- fractures of the medial condyle and medial epicondyle of the humerus
- fractures of medial malleolar

Pediatric physeal fractures have traditionally described by the Salter-Harris classification in which displaced fractures of types III and IV often require open reduction and internal fixation in order to integrate intraarticular disruptions [2]. According to general instruction, crossing the physis with any form of fixation should be avoided, if possible, [3] in order to prevent growth disorders, such as complete growth arrest and progressive angular or rotational deformities due to destruction of epiphyseal circulation (inhibits physeal growth), or by formation of bone bridge (a physeal bar) across growth plate [2].

However, if the fixation of physeal fractures by crossing through the growth plate is demanded, fixation with small bioabsorbable pins can be safely done without significant growth disturbance, as the pins size remains less than 3 % of the total cross-sectional area of the growth plate [1]. The advantage of the bioabsorbable device fixation in physeal fractures of children is that a second procedure for hardware removal is not required.

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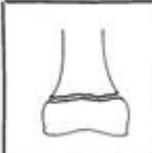
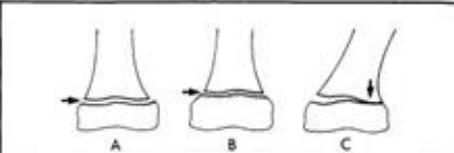
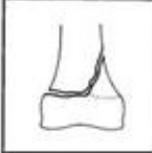
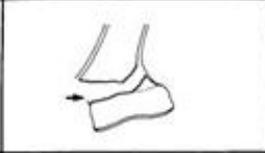
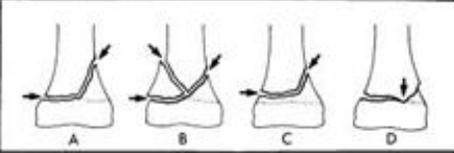
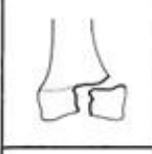
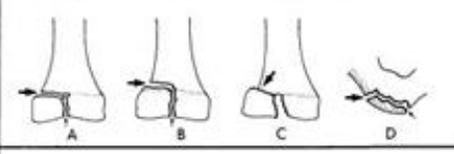
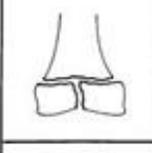
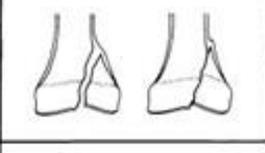
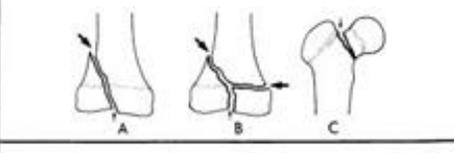
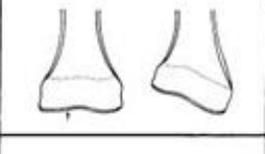
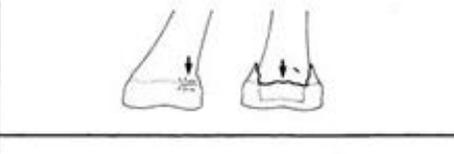
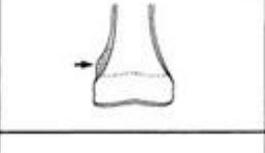
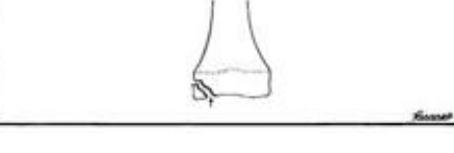
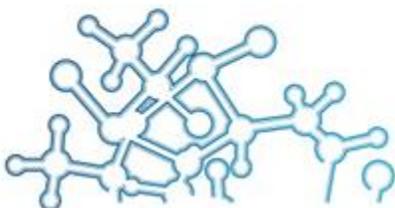
Type	Poland	Salter-Harris	Ogden
I			
II			
III			
IV			
V			
VI			
VII			

Figure 1 Classification of physeal injuries by Poland, Salter and Harris, and Ogden. All three systems are similar, but from left to right are increasingly complex. Salter-Harris classification is a refinement of Poland's system, and Ogden's classification, which is all-inclusive, adds more subclasses to simpler systems.[3]

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General instructions for bioabsorbable pin implants

- The goal of the operative treatment is to restore the anatomy of the growth plate using hairline reduction followed by fixation with small-diameter biodegradable rods.
- In the physeal fracture the reposition of the cartilaginous fragments as anatomically as possible is important; otherwise, the resulting offset will cause a bony bridge and joint incongruity.
- Try not to cross the physis, but if necessary, place transpepiphyseal pins perpendicular to the growth plate - in this way the devices do not cause significant interference with the longitudinal growth
- Use pins rather than threaded K-wires or screws to ensure undisturbed healing of a physeal fracture and to minimize the risk of growth disturbances
- Avoid unnecessary drill holes that later may become iatrogenically created pathological fractures.
- Use appropriate additional immobilization (e.g. suitable cast, brace) during bone healing.

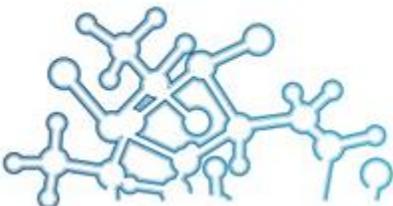
Pins or nails of small diameter traversing the growth plate at a perpendicular angle cause less growth retardation than, e.g. a cancellous bone bridge of equal size [4]. If threaded K-wires or screws are placed across the growth plate and they mechanically fix the epiphysis to the metaphysis, they may cause growth arrest.

In addition to selecting of proper fixation device, the special surgical anatomy of the physis has to take into account. For example, eighty percent of humeral growth occurs at the proximal physis and each physis, besides being undulated, also is unique in contour at each joint and is not just a flat plate. However, in the cases of physeal fractures the growth disorders are common in spite of used fixation method, therefore the parents has to be warned complications such as bony bridge formation, angular deformity, and avascular necrosis.

References

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- [3] Campbell's Operative Orthopaedics, Volume 2, 3rd edition (1998) Edited by S. Terry Canale, Mosby Inc, USA, pp. 1393 –
- [4] E. Antero Mäkelä, Academic dissertation, "Fixation properties and biodegradation of absorbable implants in growing bone, an experimental and clinical study", Helsinki 1989

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