Limb Lengthening in Children: Pin Tract Infection
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**Introduction:** Pin tract infection is the most frequent complication during limb lengthening using external fixation. Many clinical studies showed that almost all patients undergoing limb lengthening experienced pin tract infection. Although many causes of pin tract infection have been identified and strategies have been used to diminish them, they are still a common problem, which needs to be addressed. Pin tract infection is rated as a minor complication by many authors, however, it can lead to chronic osteomyelitis and decrease the stability of the pin-bone interface. Contemporary techniques of external fixation using either manually inserted self-drilling half-pins, tapered pins used after drilling a pilot hole, use of fine tensioned wires, meticulous pin site care are employed during limb lengthening, but patients are still burdened by pin tract infection. The purpose of our study was to evaluate the incidence of pin tract infection during limb lengthening using external fixation and how it affects the final outcomes and prevalence of additional procedures.

**Materials and Methods:** This is a retrospective study of eighty-eight consecutive patients who underwent 62 tibial and 54 femoral lengthenings between January 1990 and December 2003. The etiology was congenital in 46 lengthened segments and acquired in 70 lengthened segments. The patients mean age was 13.5 years (range: 4-20 years) at the time of surgery. Follow up was from 2 to 12 (mean 4) years. There was lengthening alone in about half of cases (57 bones, 49.1%), 2-dimensional deformity correction – 41 bones (35.3%), and 3-dimensional deformity correction – 18 bones (15.5%).

Retrospective review of hospital and clinic data was performed. Records were reviewed for the external fixator type, number of pins or wires used, external fixation length (days), the length of distraction regenerate (cm), angular correction, lengthening percentage (percent increase in bone length), lengthening index (days/cm), complications, pin site care and treatment, and additional surgeries. Pin tract infections were divided in two groups: wire and half-pin site infection. Also we compared the rate of half-pin site infection in half-pin fixators and hybrid external fixators. All patients received parenteral prophylactic perioperative antibiotics. Statistical analyses were conducted using SAS (SAS Institute INC, Cary, NC, USA). T-Tests: Two-Sample Assuming Unequal Variances and ANOVA followed by post-hoc t-tests with an alpha level of p<0.05 was applied. Continuous data were reported as the mean ± standard deviation.

**Results:** The lengthening index was 33±1.1 days/cm, distraction regenerate length: 6±0.4 cm, lengthening percentage: 21±2.1, external fixation length: 181±86 days. Fifty-five hybrid fixators were Ilizarov (Smith & Nephew, Memphis, TN) and one was EBI (EBI Medical Systems Inc., Parsippany, NJ). Of the half-pin fixators there were 37 Ilizarov (Smith & Nephew, Memphis, TN), 2 EBI (EBI Medical Systems Inc., Parsippany, NJ), and 2 Orthofix (Orthofix SRL, Verona, Italy). The rate of pin tract infection was 96.6%. The rate of half-pin site infection was significantly higher in half-pin fixators (100%) than in hybrid fixators (78%) (P<0.05). There was a significantly higher incidence of half-pins site infection (78%) than wires sites infection (33%) in hybrid external fixation (P<0.05). All 5 cases of osteomyelitis were associated with grade 3 half-pins site infection. Also 3 cases of half-pin site grade 2 infection were associated with Bacteremia, Bacterial endocarditis, and Toxic shock syndrome. The most common etiology of pin tract infection was Staphylococcus aureus (47.1%), followed by Staphylococcus epidermidis, Escherichia coli, and Pseudomonas aeruginosa. The rate of additional surgeries and interventions due to pin tract infection were greater associated with half-pins sites than wires sites.

**Discussion:** The results of limb lengthening in children via distraction osteogenesis are impressive. Although the gain in bone length is imposing, the outcomes should be evaluated in the context of extended time in external fixator and the fact that many complications occur and additional procedures are needed. In this study we assessed a qualitative parameter of distraction osteogenesis: the incidence of pin tract infection during limb lengthening and how it affects the final outcomes and prevalence of additional procedures.

While the instigators of the technique did not report a significant rate of pin tract infection, our study found it a concerning aspect of distraction osteogenesis. Despite regular daily local cleansing, patients developed the pin-site infection in most of cases. Pin tract infections were treated by increasing the frequency of local cleansing, protecting the pin site with dressing, and oral antibiotics. Five cases of grade 3 and 3 case of grade 2 pin tract infections were treated with intravenous antibiotics. In 5 cases pins were removed and in 8 cases pins were exchanged without compromising the stability of the frame. Although a further surgical procedure was required in 18 cases due to pin tract infections, it did not significantly lengthen the time in the frame or affect the lengthening protocol. All pin tract infections fully resolved by the end of the treatment period, except 3 cases (3.4%), which persisted after external fixator removal and lead to chronic osteomyelitis. Nowadays it is well recognized that pin tract infection is the most frequent complication during limb lengthening using external fixation. There are variations in the rate of pin tract infection. Part of this variation may be the result of differences in the way authors report complications. Some authors report minor pin drainage, others only pins with osteolysis, which would generally be considered a deep infection. Our results are in good accord with many previous studies on pin tract infection with contemporary external fixation. The most common etiology of pin tract infection in our patients was Staphylococcus aureus (47.1%) followed by Staphylococcus epidermidis (11.8%). The incidence of chronic osteomyelitis following pin tract infection in our patients was 3.4%. We found same bacteria (Meticillin-Resistant Staphylococcus aureus) in cultures of all three patients with chronic osteomyelitis. Also in all three patients first cultured bacteria associated with pin tract infection was Meticillin-Resistant Staphylococcus aureus. Our data indicate that half-pin external fixators are associated with a higher incidence of pin tract infection than hybrid fixators using fine wires in addition to half-pins. It seems that the half-pins site is more prone to pin tract infection than fine wires site. Also the rate of additional surgeries and interventions due to pin tract infection were higher associated with half-pins site. From our data it is an apparent tendency in increase of pin tract infection with increase in length of external fixation. The patients must be fully informed, well educated and seen frequently. Detected pin tract infections must be treated aggressively preventing infection spread. Additional methods of preventing pin tract infection need to be developed.