TECHNICAL REPORT

Two Consecutive Limb Lengthenings with the Same PRECICE Nail—A Technical Note

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Abstract

Aim: A significant advance in limb lengthening is the magnetic lengthening nail; first reports show good results with accurate lengthening and good regenerate bone formation. This technical report describes the use of a single device for two consecutive lengthenings in the same bone.

Methods: The authors present a case in which the limb lengthening has been performed in consecutive lengthening periods using the same nail. The nail retracted by altering the settings on the external remote control (ERC) after the bone union was complete from the first lengthening. After a repeat osteotomy, the second lengthening was accomplished.

Results: After the two consecutive femoral lengthenings with the same PRECICE nail, no significant lower limb length discrepancy remained and there were no recorded complications.

Conclusion: This technique utilizes the principles of lengthening by Ilizarov but with a modern magnetic lengthening nail. By this method, there can be the avoidance of prior nail removal and reinsertion of another nail. This minimizes complication rates and overall time for recovery.

Level of evidence: Level IV

Keywords: Deformity, Lengthening, Limb, Magnetic, Nail.

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Introduction

Research and progress with medical devices have led to continual improvement in limb lengthening.[8] Many have contributed to the development of various limb lengthening techniques using the principles of Ilizarov and external fixation and, more recently, lengthening nails.[1]

A significant advance is the magnetic lengthening nail (PRECICE System, Nuvasive, USA) with encouraging first reports.[3,4,7,9] This avoids external fixation and is activated transcutaneously by an ERC unit. This facilitates a reduction in the patient's pain and they have a quicker and more effective rehabilitation.[1,2,8]

The PRECICE nail is a magnet-operated telescopic internal lengthening device with an ERC that contains two rotating magnets. When placed by the patient on the skin overlying magnets within the nail, the activated ERC will cause this internal magnet to rotate which in turn causes elongation of the telescopic component; the nail can be both extended and retracted by altering the settings on the ERC. Accuracy can be controlled through the ERC; a distance of 1 mm requires the ERC to be placed over the magnet within the nail for 7 min.[6]

The reported complication rate has been low with the most common are implant failure to lengthen, nail breakage, and premature consolidation; most are associated with poor implant choice (too short vs too long nail; small vs large nail diameter) and difficulty of activation by the ERC in the proximal femur mainly because of the width of the soft tissues in obese patients.[2–4,7,9]

The high cost of this device and the relatively short follow-up (<5 years in most publications) remain obstacles to the adoption of the technique as a gold standard for limb lengthening. Cost analyses do demonstrate that the PRECICE nail can be more cost-effective when compared to lengthening with external fixation.[5,10]

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Patient and Methods

A 9-year-old girl seen by our children's orthopedic department was diagnosed with a right limb (femur) length discrepancy of 35 mm (a sequelae of meningococcal septicemia—Fig. 1).

A right femoral lengthening was performed with an intramedullary magnetic nail—PRECICE (antegrade femur; diameter: 8.5 mm; telescoping rod: 30 mm; length: 170 mm). After implantation of the nail, a first distraction of 1 mm was performed with the patient still under anesthetic. At 7 days after surgery, distraction was started at a rate of 1 mm/day until the maximum of distraction capacity of the nail of 30 mm was achieved. This occurred 38 days after the first surgery. The patient was seen at different intervals with radiographs to monitor lengthening and bone union (Figs 2 to 4). After 6 months, radiographic bone union (corticalization in the regenerate bone observed in at least three cortices) was achieved. At this time, the patient still showed a right limb (femur) length discrepancy of 2.0 cm (as the left limb continued the normal growing process).

At 1 year following the initial surgery, a second surgery to remove the distal locking screws was carried out in the outpatient department under local anesthesia (Fig. 5). With this done, the

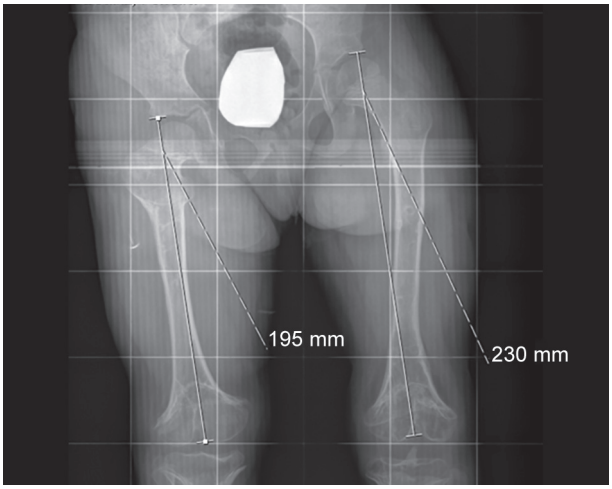

Fig. 1: Preoperative X-ray with a right limb (femur) length discrepancy of 35 mm

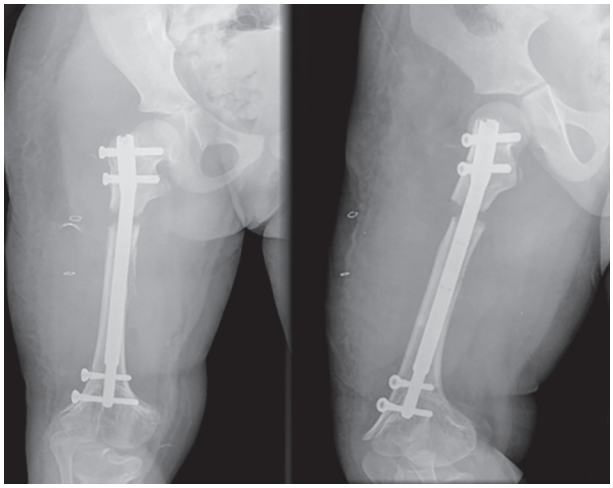

Fig. 2: Two weeks postoperative

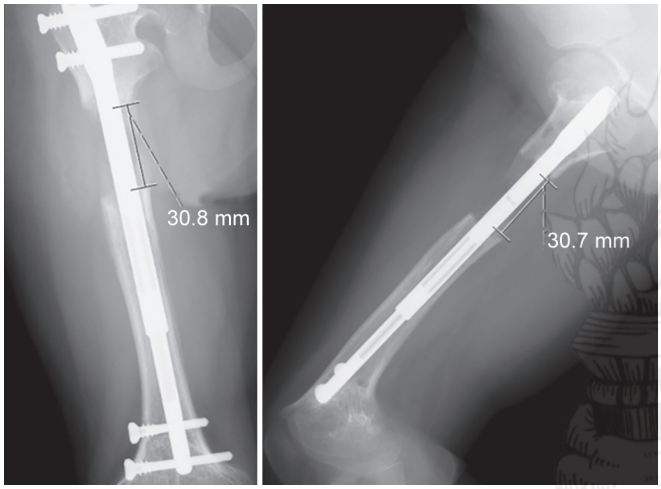

Fig. 3: Two months postoperative

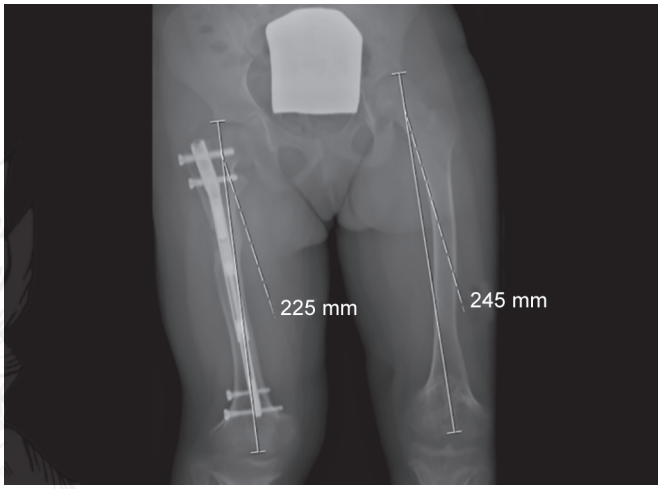

Fig. 4: Six months postoperative

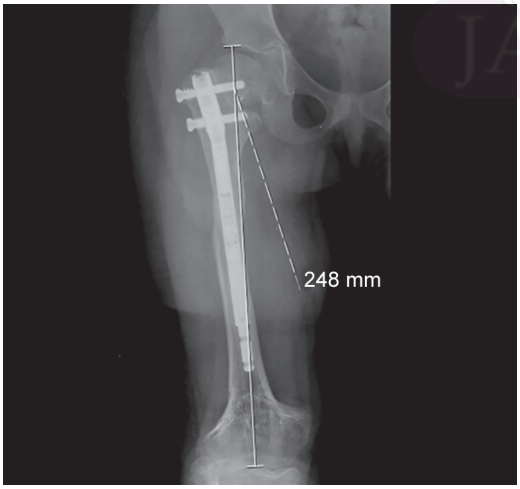

Fig. 5: Postoperative X-ray after second surgery to remove distal locking screws

patient was instructed to perform retraction of the nail using the ERC (with an inverted program lasting 2 hours).

Three weeks later, the third surgery was carried out to insert new distal locking screws in the retracted nail. At the same time, a new bone osteotomy (localized to the position of the nail magnet) was done (Fig. 6). The same protocol was followed: a first distraction of 1 mm was performed in the operating room; 7 days after surgery, we restarted the distraction with a rate of 1 mm/day until we achieved the limb distraction necessary (30 mm). The patient was seen at different intervals with radiographs to monitor lengthening and bone union (Figs 6 to 8). After almost 6 months, there was radiographic bone union and with a resolution of limb length discrepancy.

Results

Two successful consecutive limb (femoral) lengthening operations were conducted with the same PRECICE nail with complete resolution of limb length discrepancy. As the patient was 12 years old at the end of the treatment, she remains under follow-up at standard time intervals with lower limb radiographs to monitor the lower limb growth and options to prevent a possible new length discrepancy.

Discussion

The aim of this paper is to describe a special technical use of the PRECICE system: the nail can be extended inside the patient limb (after the osteotomy) but it also can be retracted inside the

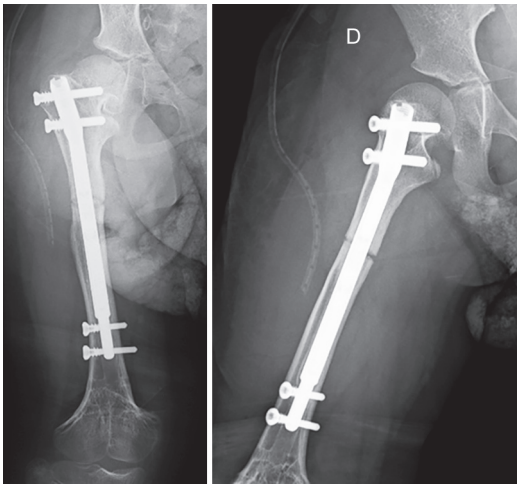

Fig. 6: Postoperative X-ray after third surgery (new osteotomy and impute of distal locking screws)

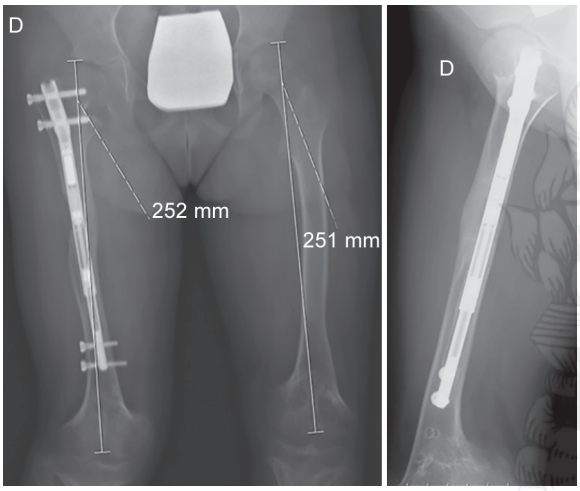

Fig. 8: Six months postoperative

limb after achieving the bone union (the distal screws have to be extracted and the settings on the ERC changed to facilitate retraction). There were no minor or major complications associated with this procedure for this single case.

While recent research demonstrates that patients prefer internal limb lengthening devices to that by external fixation,[3,4,7,9] it is important for associated healthcare facilities to examine the clinical and economic implications. There are reports that the PRECICE is a cost-saving alternative to external fixation due to the lower rates of surgical complications and shorter inpatient hospital stays associated with the procedure.[5,10] Although this single case report prevents a direct comparison with other lengthening techniques, there is a need for a wider analysis to assess the real cost-effectiveness of internal device lengthening as compared to external fixation options.

Conclusion

The intramedullary lengthening nail helps decrease patients' pain and discomfort while facilitating rapid and effective rehabilitation when compared with conventional techniques using external fixation. This clinical case is the first described in which the limb (femoral) lengthening has been performed in consecutive

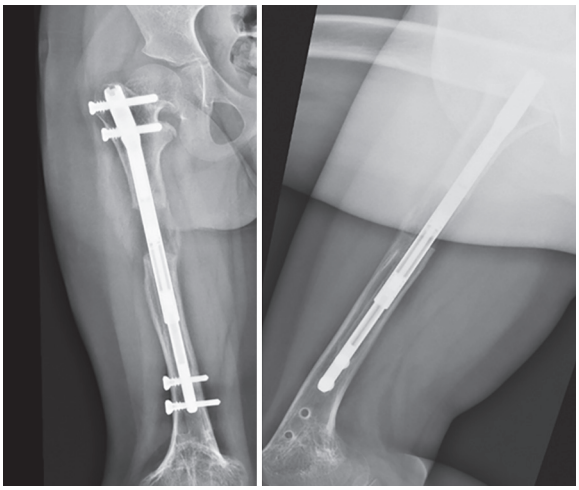

Fig. 7: Two months postoperative

lengthening periods using the same PRECICE nail with a good clinical result and high patient satisfaction.

Ethical Approval

All procedures performed in the study involving human participant were in accordance with the ethical standards of the institutional and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Consent

A written patient consent and permission to publish have been obtained. The images are completely anonymous (radiographs) and the text does not carry any identifying information.

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