**NON-INVASIVE PROSTHESSES DISTRACTION**

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*Abstract—*Anatomically immature patients with various physical deformities face the obstacles of growth-friendly prosthetic devices to cooperatively treat the issue, without restricting the growth of the patient. Growth-compatible prostheses more often than not, require invasive surgical adjustments which create scar tissue and chance the patient acquiring infection. Devices such as motors or magnets capable of surgically adjusting internal prostheses non-invasively reduce the chance of complications post-operation.

I. INTRODUCTION

CHILDREN with very rare but severe diseases such as Early Onset Scoliosis (EOS) or malignant bone tumors. Vertical Expandable Prosthetic Titanium Rib (VEPTR) and Growing Rods (GRs) are two of the most customary devices for treating EOS in patients with severe spinal deformities—both of which require invasive surgical adjustments generally every 6 months [1]. Another example of incidents where prosthetic adjustment is invasively operated are for skeletally immature patients who acquire malignant bone tumors—these aid in continual bone growth with regards to the affected limb [2].

II. SPINAL EXTENSIONS

Children who attain scoliosis between 6 months and 5 years old are in a subdivided group of classifications which have come to be titled as Early Onset Scoliosis (EOS). These patients require growth friendly options that do not prohibit their continuing skeletal growth. Magnetically Controlled Growing Rods (MCGRs) have become a viable solution to treatment for patients; they perform the same function as conventional prosthetic rod systems, but are built with a magnetic actuator attached to the system, allowing for non-invasive surgical rod lengthening. Magnets in the actuator are controlled by an External Adjustment Device (EAD) which houses permanent magnets. Placing the EAD on the skin over the actuator translates a predetermined measurement for the rods to either extend or retract. The actuator has a threshold of 270N, at which point it cuts out [3].

III. LIMB EXTENSIONS

Malignant bone tumors often require partial bone resection. Temporary prosthetics promote growth of bone to eventual normal bone structure and length. In pediatric cases, the prosthetic requires the capability for extension with growth. The implant prosthetic envelops a "telescoping shaft where the expansion is done by a power screw driven by a gearbox connected to an NdFeB magnet [2]." The prosthetic is capable of extending under an axial load of 1350N. The prosthesis is extended by placing the limb through an external drive unit. As the drive unit is turned on, it produces a rotating magnetic field capturing the implant magnet causing it to rotate in synchronization. At full speed, the implant grows at a rate of 0.23mm per minute.

IV. RESULTS/CONCLUSION

Traditional spinal treatments for patients with EOS are too invasive. Patients who receive Vertical Expandable Prosthetic Titanium Rib (VEPTR) or Growing Rod (GR) implants are very prone to infection (about 20%) and a regular occurrence of bone ossification in the anchor sites of the implants [4]. Magnetically focused prostheses dramatically reduce the risk of complications for the 6-monthly adjustments, as well as the cost for the adjustment procedures is significantly lesser [6].

![Figure 1](image1.png)

![Figure 2](image2.png)

**Figure 1**

**Figure 2**

*Figure 3* [6] It would be interesting to see how primarily electrical adjustment components would compare to the magnetic technology in the prostheses for both the limb and back. The prostheses are restricted to only extend up to a specific length; the spine ~50mm and limb ~300mm. This is an area of the technology that could be further explored.

REFERENCES


