Facts about Osteogenesis Imperfecta

Rodding Surgery

Introduction
Rodding surgery, also called intramedullary rodding, is the placement of a metallic device called a rod or nail into the internal cavity (medullary canal) of a long bone.

Purpose of Rodding
Not everyone with OI needs intramedullary (IM) rods. Children and adults who rarely fracture and have straight bones do not need rods. The most common indications for rodding are:

- Progressive deformity of a bone,
- Repeated fractures; particularly in the legs,
- Functional limitations; particularly in the arms.

A curved or bowed long bone is not *in itself* a reason for rodding unless it gets worse, repeatedly breaks, becomes painful, or interferes with function. Rodding does not always *prevent* fractures, but the rod will provide an internal splint that can reduce the risk of displacement of the bone. An already rodded bone may require shorter periods of casting and inactivity after a fracture. This, in turn, can help break cycles of inactivity that often lead to additional fractures. Walking may be improved after rodding surgery in the child who is ready to walk but is held back because of repeated fractures. However, rodding surgery by itself will not guarantee that the child with a severe form of OI will learn to walk.

For children and adults with OI, rods are preferred over plates and screws to repair fractures. Plates and screws create a very stiff, short segment within the bone. The bone is likely to break above or below the plate and long term use can lead to thinning of the bone underneath the plate.

Timing of Surgery
Rodding is usually undertaken as a scheduled elective procedure. An optimal age for a first rodding surgery has not been established. Rodding the long bone in the legs is often considered when a child with bowed legs pulls up to stand. This may be as early as age 18 months. The family and surgeon should develop a plan in case the bone breaks prior to surgery. Often the rodding can be done at the time of the fracture. Bones in OI may be thin and flat, so they often appear wider in diameter on an X-ray than they actually are. The bone must have a large enough diameter to accept a rod. As the child grows, the decision about when to revise a rod in a bone that is not fractured is complicated and depends on the child's symptoms (whether the rod is painful or protruding) or the likelihood of the bone breaking in the unprotected segment.

Types of Rods
There are two major types of rods: **regular (non-telescopic)** and **telescopic (expanding)**. Surgeons agree that no single rod is appropriate for all situations. Three important considerations for selecting rods for children with OI are the small diameter and length of their bones, prospects for bone growth and the experience of the surgeon. The orthopedic surgeon matches the rod properties to the specific needs of the child or adult. For instance, a rod typically used in the humerus may be the right size to use in the femur of a small adult. The rod should be small enough to fit into the bone canal and stiff enough to support the bone. The rod should not be so large or stiff that it completely shields the bone from stress. Some stress on the bone is necessary for developing and maintaining bone density. Rods can be made of stainless steel or titanium.

Regular rods do not expand. They have many uses, and come in many sizes. They are typically less expensive than telescopic rods and easier to insert, but in growing children they may need to be replaced after 2 years. For children with very short, thin bones, they may be the only option. They are inserted to support the full length of the long bone. Bowing may occur beyond the point where the rod ends.

Telescopic rods consist of a thinner rod inserted into a larger hollow rod. They lengthen as the bone grows which may prevent or postpone the need for replacement. The smallest diameter expanding rods are still too large for some bones. The bone must also be strong enough to allow the rod to be "anchored" at either end. Telescopic rods are more expensive and more difficult to insert than regular rods, but they usually require fewer operations as they may last 3-4 years in a growing child. Telescoping rods are often chosen when there is the potential for growth. Telescoping rods are not indicated in anyone who has ceased growing.

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Rods frequently used in OI bone include: Fassier-Duval telescopic, Bailey- Dubow telescopic, Rush, Sheffield, and K-wire.

Surgery and Bisphosphonates

Many surgeons recommend that children receiving bisphosphonates discontinue treatment before rodding surgery. There is no agreement as to how far in advance to suspend treatment, but the minimum suggestion is not to treat immediately before surgery. During a bisphosphonate treatment, the drug is drawn to the site of increased bone formation and could become concentrated in the area around the osteotomy or new fracture and thus interfere with healing. Treatment can be resumed when healing is well established. In addition, if the bone has been treated with bisphosphonates within the last several years, then special surgical techniques, such as using a hand saw instead of a power saw, are recommended to optimize complete healing.

Surgery and Aftercare

Rodding procedures are most often undertaken in the femur or tibia and occasionally, the upper arm bone (humerus). Rodding is considered major surgery and the pros and cons of having the surgery should be carefully discussed. Additional topics for discussion between the surgeon, parents, or OI adult include the following:

- Physical activity prior to surgery,
- Length of the operation; anesthesia issues,
- Reason for the choice of rod,
- Time in the hospital,
- Length of recovery time at home,
- Pain management including control of muscle spasms,
- The rehabilitation plan.

It is usually OK to allow the child or adult with OI to continue their usual physical activities, including swimming, prior to surgery.

Other Considerations

Osteotomy is a surgical procedure that is often part of rodding. It involves cutting and removing thin wedges of bone so that the curved bone can be straightened.

Casts or splints are typically needed for about four weeks after surgery since healing time for OI bone is normal. Because people with OI face frequent periods in a cast due to surgery or fractures, steps should be taken to prevent immobilization osteoporosis. **A guiding principal is to immobilize the broken or rodded bone with lightweight material for the shortest period of time possible.**

Following tibia surgery, an above-the-knee cast or splint is used. The knee may be bent so that the child can sit in a wheelchair or stroller. Casting following femoral surgery is more difficult. Options include splinting, hip spica casts, and A-frame casts (a bilateral long leg cast with a connecting bar that prevents rotation). Whenever possible surgeons experienced with OI prefer to avoid spica casts, choosing an above-the-knee splint or lightweight plaster or fiberglass splint instead. Bracing may be used after the removal of the cast to provide added support for standing and walking.

Physical therapy is required for most people with OI after rodding surgery. Swimming or water therapy is frequently advised. Some physicians also prescribe physical therapy during the recovery period to maintain muscle strength in limbs not affected by the surgery. The length of the recovery period is determined by the extent of the surgery, the type of rod, the patient's age and activity level.

Potential Complications

Complications from rodding surgery include risks related to:

- General anesthesia,
- Fractures during the procedure,
- Infection, and
- Bleeding.

Complications that can occur after the surgery include:

- Rod migration,
- Mechanical failure of the rod (it does not expand),
- Re-fracture or re-bowing of the bone.

Rod Replacement

A rod that is not causing pain or interfering with function can be left in place for many years. Adjustment to a rod is needed when:

- The rod migrates into the joint or outward,
- The rod becomes damaged, bent or fails to elongate,
- The child grows, and there is an unprotected area of the bone that is at risk for fracture,
- New bone deformity occurs.

Whether the rod needs to be removed, replaced or trimmed depends on the quality of the bone seen on x-ray, as well as the presence of pain, or the appearance that a fracture is likely to occur.

Adults often have rods that were placed during their teen years. It is not harmful to leave an old rod in the bone. Rods occasionally become painful in adults. If there is pain or significant deformity interfering with the person's ability to function, the rod should be trimmed or removed. Removal can be difficult. It is beneficial if the surgeon can study records from the original rodding surgery.

Conclusion

Surgeons continue to debate the choice of rod (telescopic v regular), the rod materials (stainless steel v titanium) and the age for a first rodding surgery. Regardless of the type of rod chosen, complications tend to be minimized when the orthopedic surgeon is well experienced with the principles of rodding in brittle bones.

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Thank you to Dr. Peter Smith, Shriners Hospital for Children, Chicago, IL, for reviewing this document. March 2015.