

Risk Factors for Growing Rod Fractures

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Background information

Rod fractures are common complications during growing rod treatment

No study to date to examine the risk factors for rod fractures

Hypothesis

Risk factors for fx are predictable
 Implant related factors exist

 May be modifiable

Patients/Methods

393 patients from 16 centers studied
 44 patients with 71 rod fractures
 Average growing rod time: 54 months

 Compared with non-fracture patients in the database

Risk factors studied
 – implant-related
 – patient-related.

Methods: Risk Factors Studied

Implant related: Rod diameter, material, number, length of instrumentation, anchor type, proximity (<1 cm) to connectors, crosslinks and anchors.

Patient related: Diagnosis, age, gender, weight, major Cobb angle, ambulatory status, treatment duration and number of lengthenings

Results

Average time to fracture after initial insertion was 25±22 months

Results: Construct

Single rods had a higher rate of fracture than dual rods
 - 34% vs. 11%, P<0.001
 - Controlled for rod size and rod material

In dual rod constructs, only 15% of fractures involved both rods

Results: Material and Size

- Stainless steel rods had a higher fracture rate than titanium rods (trend)
 - 19% vs. 12%, P=0.06
 - Controlled for rod diameter, single vs dual



- The mean rod diameter was smaller in the fracture group
 - 4.1 mm vs. 4.8 mm, P=0.01
 - Controlling for rod material and number of rods

Results: Location

Most common fracture locations were at tandem connectors (30/71)
 No difference above (17/30) or below (13/30)
 Within 10 mm



Results: Location

Other locations included:
 Mid-rod (31/71)
 At hooks (7/71)
 At screws (2/71)
 At crosslinks (2/71)









Results: Tandem Connector Size

Fracture group had smaller mean tandem connector length

Fx grp: 62±14mm, Nonfx Grp: 74±24mm
P<0.001

Controlled for rod size, material, number
 Tandem vs side-to-side connectors:
 – NS

Results: Constructs

Pelvic fixation did <u>not</u> increase risk of fracture

– Fracture grp: 24%

– Non-fx grp: 18%

-P=0.38

Levels of fracture

Thoracic (T2-10): 20
Thoracolumbar (T11-L1): 21
Lumbar (below L1): 13



Do large curves increase Risk?

No difference in pre-op Cobb angle

 Fracture group: 71°
 Non-fracture group: 74°
 P=0.2

Convexity/Concavity

For dual growing rods with single major curve:

- Rod fractures on convex side: 10
- Rod fractures on concave side: 6



Results: Lengthening and Ambulation

- Lengthening frequency:
 - Fx group was lengthened 1.18 times/yr
 - Non-fx group was lengthened 1.26 times/yr (P=0.8)
 - Controlled for rod size, material and construct
- Ambulation: trend towards increased fracture risk
 - Ambulators: 24% fx risk (28/120
 - Non-ambulators: 18% (16/248), P=0.08
 - Controlled for rod size, material, and construct

Diagnosis

Risks for fracture per Diagnosis
 – Syndromic: 14% (9/64)
 – Neuromuscular: 2% (2/94)
 – Congenital: 6% (6/99)
 – Idiopathic: 5% (9/160)

 Syndromic had a higher risk for fracture than neuromuscular diagnosis (P=0.01)
 – Controlled for rod size, material and number

Results: Demographics

No difference in age at initial surgery

 Fracture grp: 69 mos vs. Non-fx grp: 82 mos, P=0.2

No difference in gender

Results: Repeat fractures

Repeat fractures occurred in 30% (13/44) patients

-3 fx (2), 4 fx (1), 6 fx (1)

- Primarily with single rods (77%, 10/13)
- Significantly less in dual rod constructs (23%, 3/13), P=0.02
 - Pt with dual rod fx still increased risk
 - For dual rod constructs, all repeat fractures occurred on the ipsilateral side



Results: Complications/Treatment

- Eight wound complications were reported
 - 3 through skin

Rod fractures salvaged by:
 Adding tandem connectors (20)
 Replacing the broken rods (44)
 Final Fusion (2)



Conclusions

Implant risk factors for rod fracture:

- single rods
- small rod diameter
- stainless steel rods
- proximity to tandem connectors
- small tandem connectors

Patient-related: ambulation, prior fx
 Repeat fractures remain a challenge

Conclusions/Suggestions

Rod Fracture is common (11%)
 Consider Fx risk in designing construct
 Avoid proximity of tandem connectors to anchors or crosslinks

 When rod fractures, consider replacing entire construct?
 – Further work is indicated



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