Redirectional Acetabular Osteotomies for Neurogenic and Syndromic Hip Dysplasia

Wudbhav N. Sankar, MD (7-Wolters Kluwer Health-Lippincott Williams & Wilkens)  
The Children’s Hospital of Philadelphia

Options for pelvic osteotomies in neurogenic and syndromic dysplasia
- Similar to the options for conventional dysplasia
- Three general categories:

I. Reshaping osteotomies
   a. Examples: Dega, Pemberton, San Diego etc.
   b. Mainstay of treatment for many patients with neuromuscular dysplasia
   c. Involve incomplete cuts in the ilium
   d. Correction achieved by hinging on triradiate cartilage
   e. Changes shape not orientation of acetabulum
   f. Best for capacious acetabula

II. Salvage procedures
   a. Examples: Shelf, Chiari
   b. Indicated for incongruous hips which are not amenable to other options
   c. Uses capsule as weight-bearing surface rather articular cartilage

III. Redirectional osteotomies
   a. Focus of this presentation
   b. Examples: Salter, Triple, Periacetabular osteotomy (PAO)
   c. Involve complete cuts and therefore require internal fixation
   d. Do not change the size of the acetabulum but do reorient the position of the acetabulum
   e. Covers hip with articular cartilage
   f. Requires congruency or near congruency
   g. Salter less useful in neuromuscular dysplasia and older patients
   h. “Complete” redirectional osteotomies (e.g. Triple, PAO) completely free the acetabulum and allow large corrections and ability to correct in multiple planes

1. *Triple Osteotomy*
   I. Described by Le Couer, popularized by Steel, Tönnis
   II. Complete cuts of ilium, ischium, and pubis
   III. Triradiate spared so can be performed in skeletally immature
   IV. Several techniques: 2 incision (Wenger, Bowen, others), 1 incision (O’Connor, Zaltz)

Results of Triple osteotomies in neurogenic and syndromic dysplasia
Rebello et al, JPO 2009
- 31 neuromuscular hips (flaccid and spastic)
- Mean age 9.6 years
- All underwent triple osteotomy alone
  - LCEA improved from 1.1° to 39°
  - Migration index decreased from 43% to 4%
- 1 pubic nonunion, 1 sciatic nerve palsy in patient with CMT
- 2 pts with CP had persistent subluxation
- No premature closures of triradiate cartilage

2. *Periacetabular Osteotomy (PAO)*
   I. Many techniques
   II. Bernese (Ganz) most popular
   III. Circumferential cut through single incision
   IV. Posterior column left intact
   V. Violates triradiate cartilage so indicated for skeletally mature

Results of PAOs in neurogenic and syndromic dysplasia
MacDonald et al. JBJS B 1999
- 13 neuromuscular hips (flaccid and spastic)
- Mean age 23 years
- All underwent PAO ± varus femoral osteotomy
  - LCEA improved from -10° to 25°
  - Tönnis angle improved from 33° to 8°
  - Migration index decreased from 53% to 15%
- Pain reduced or eliminated in 11/11 hips
- 1 iatrogenic FAI
- 1 late subluxation requiring varus osteotomy

Potential advantages of redirectional osteotomies in neurogenic and syndromic hip dysplasia:

I. Applicable to skeletally mature
   a. Reshaping osteotomies after maturity?
      i. Robb and Bruner, JBJS B 2006
         1. 52 hips, non ambulatory CP
         2. All skeletally mature
         3. Dega osteotomy plus VDRO
         4. Migration index improved from 70% to 10%
         5. 5 acetabular fractures, 1 osteonecrosis of acetabular fragment
      ii. Can be done, but a stretch of the intended technique
   b. Preferred option is a complete redirectional osteotomy (PAO) as triradiate is already closed
      i. Can be combined with VDRO if needed
II. **Ability to change acetabular version**
   a. Archetype: Down Syndrome dysplasia
      i. Incidence of hip instability in Trisomy 21 is 1-7%
      ii. Ligamentous laxity a factor
      iii. Increased acetabular retroversion compared to DDH and normal controls (Sankar et al, JPO 2012)
         1. Consistent with posterior direction of hip dislocations
         2. Role of redirection osteotomy to correct retroversion and potentially stabilize Down Syndrome hip?
   b. Sankar et al, JBJS A 2011
      i. Retrospective review of all Trisomy 21 patients treated at Children’s Hospital of Boston for “gross” instability or “micro” instability (dysplasia)
      ii. Patients divided into Group A (Redirectional osteotomy i.e. Triple or PAO) or Group B (varus femoral osteotomy ± non redirection pelvic procedure e.g. shelf, Dega)
      iii. 35 hips (25 in Group A, 10 in Group B)
         1. 17 hips grossly unstable
      iv. Mean age 11.9 years, Mean F/u 4.4 years
      v. Group A (redirectional osteotomy group) had worse initial pathology than Group B with a lower mean LCEA (1° vs. 15°) and higher mean Tönnis angle (21° vs. 10°)
      vi. Postoperatively, however, Group A had better results than Group B based on lower mean extrusion index (10% vs. 29%), higher LCEA (33° vs. 14°), and lower Tönnis angle (-1° vs. 10°)
      vii. Group A (redirectional osteotomy): 10/11 (91%) unstable hips were stable at final follow-up
      viii. Group B: 3/6 (50%) unstable hips were stable at final follow-up
         1. 2 of 3 failures eventually stabilized by Triple or PAO
      ix. Conclusion: Redirectional osteotomy effective for stabilizing Down’s hip
         1. Improved results due to ability to correct acetabular retroversion

III. **Useful for the hypoplastic acetabulum**
   a. In certain cases of neurogenic and syndromic dysplasia, the sourcil may be relatively horizontal, but the coverage still insufficient due to hypoplasia of the acetabulum
   b. In these cases, a reshaping osteotomy will not improve lateral coverage
   c. Redirectional osteotomies can reposition the sourcil more centrally over the weight-bearing zone to improve coverage

IV. **May better preserve marginal ambulatory ability?**
   a. Many patients with neurogenic and syndromic dysplasia have hypotonia, abductor weakness, and marginal ambulatory ability
b. Conventional approach of reshaping osteotomies and/or varus femoral osteotomies can further compromise abductor function and cause a leg length discrepancy (varus)
c. Redirectional osteotomies allow coverage of the hip through an abductor sparing approach, medialization of the hip center to improve abductor mechanics, and potential avoidance of limb shortening effect of varus osteotomy
d. May therefore better preserve marginal ambulatory ability
e. Rationale based on mechanical principles but there is no published evidence to support this opinion

V. “Hypercoverage”
a. Certain cases of neuromuscular and syndromic dysplasia are associated with severe instability and recurrent dislocation
b. Increased corrective power of redirectional osteotomies allow “hypercoverage” of these unstable hips to achieve stability

References


