Complications Related to Postoperative Casting After Surgical Treatment of Subluxed/Dislocated Hips in Patients With Cerebral Palsy

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Abstract

Three hundred sixteen subluxed/dislocated hips (222 patients) underwent upper femoral osteotomy. Of these, 286 (90.5%) hips were casted (average patient age: 8.9 years) and 30 (9.5%) were not (average patient age: 13.6 years). Average follow-up was 4.7 years. Complications in the casted/noncasted groups (per hip) were: 43/0 (15%/0%) skin sores; 11/1 (3.8%/3.3%) wound infections; 6/0 (2.1%/0%) instrumentation failures; 22/1 (7.7%/3.3%) reoperations; and 13/1 (4.5%/3.3%) rehospitalizations. Differences between the groups were not statistically significant. Casted patients were younger and more neurologically involved.

Casting is useful to ensure healing of osteotomies, prevent instrumentation failure and injury to the operated legs, and allow for ease of handling. Complications that occurred were managed and had no long-term sequelae.

Postoperative immobilization in a cast is an accepted practice for subluxed/dislocated hips in children with cerebral palsy. This is especially true for patients who are small and have severe involvement.

The advantages of casting are protection of the operated limbs, comfort, prevention of contractures, and ease of handling the child without having to reposition the limbs when moving. The disadvantages are problems with hygiene, immobilization osteopenia with subsequent limb fracture after cast removal, sores, stiffness after cast removal, and various other inconveniences associated with casts. Because of these disadvantages, several authors have advocated not casting these patients. They cite data that suggest patients do just as well if not better without the casts; postoperative complications are lower and patient/parent satisfaction is high with that practice.

At our institution, postoperative casting remains the routine for the vast majority of children with cerebral palsy undergoing hip reconstruction for subluxed/dislocated hips. However, a small subgroup of generally older, larger patients in whom sturdier implants can be used, patient cooperation is better and spasticity is less, are not casted. The overall impression is that postoperative casting is not associated with high complication rates or poor patient/parent satisfaction.

This study determined the prevalence of complications associated with casting and contrasted those rates with patients who were not casted in this and other series.

Materials and Methods

A retrospective chart and radiographic review of patients with cerebral palsy undergoing hip surgery for subluxation/dislocation, which involved at least an upper femoral osteotomy, was performed. Inclusion criteria were an underlying diagnosis of cerebral palsy, hip subluxation/dislocation, surgery that involved at least an upper femoral osteotomy, operations performed between January 1988 and December 1999, at least 3-month postoperative follow-up, and adequate records and radiographs. (Three-month minimum follow-up was chosen because complications directly or indirectly caused by casting manifest within that time. This allowed observation for the occurrence of post-immobilization fractures and restoration of joint motion.)

Charts were reviewed to obtain information on the procedures performed and complications that occurred. Radiographs documented the preoperative sta-
TABLE
Comparison of Operative Procedures on Hips Between Casted and Non-Casted Groups

<table>
<thead>
<tr>
<th>Operative Procedure</th>
<th>Non-Casted</th>
<th>Casted</th>
<th>Subtotal</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Left</td>
<td>Right</td>
<td>Left</td>
</tr>
<tr>
<td>Soft-tissue release</td>
<td>6</td>
<td>4</td>
<td>85</td>
</tr>
<tr>
<td>Adductor tenotomy, open</td>
<td>7</td>
<td>2</td>
<td>30</td>
</tr>
<tr>
<td>Adductor tenotomy, percutaneous</td>
<td>13</td>
<td>6</td>
<td>115</td>
</tr>
<tr>
<td>Subtotal</td>
<td>3</td>
<td>1</td>
<td>43</td>
</tr>
<tr>
<td>Psoas release</td>
<td>16</td>
<td>7</td>
<td>158</td>
</tr>
<tr>
<td>Total</td>
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<td>1</td>
<td>32</td>
</tr>
<tr>
<td>Varus derotational osteotomy</td>
<td>14</td>
<td>10</td>
<td>91</td>
</tr>
<tr>
<td>Blade plate</td>
<td>0</td>
<td>0</td>
<td>34</td>
</tr>
<tr>
<td>Howse</td>
<td>0</td>
<td>0</td>
<td>4</td>
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<tr>
<td>Dynamic compression plate</td>
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<td>1</td>
</tr>
<tr>
<td>Dynamic hip screw</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Other</td>
<td>16</td>
<td>11</td>
<td>132</td>
</tr>
<tr>
<td>Total</td>
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<td>0</td>
<td>2</td>
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<tr>
<td>Schantz osteotomy/valgus</td>
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<td>3</td>
<td>72</td>
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<tr>
<td>Blade plate</td>
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<tr>
<td>Other</td>
<td>3</td>
<td>2</td>
<td>7</td>
</tr>
<tr>
<td>Total</td>
<td>13</td>
<td>8</td>
<td>92</td>
</tr>
</tbody>
</table>

RESULTS
In group A, 238 casts were used postoperatively involving 286 operated hips (100 right, 90 left, and 48 bilateral hips). The casts consisted of 142 double spicas and 96 single spicas; no Petrie casts were used. Average duration of casting was 45.7 days. In group B, 28 surgeries were performed in 30 hips (9 right hips, 17 left hips, and 2 bilateral hips).

All surgeries involved at least an upper femoral osteotomy, but a number of associated procedures were performed at those sessions (Table). The most common associated procedure was adductor tenotomy in 249 (79%) hips followed by acetabuloplasty in 216 (68%) hips, and open reduction in 62 (20%) hips.

Average patient age at surgery for both groups was 9.4 years and average follow-up was 4.7 years. However, the age at surgery for group A was 8.9±4.2 years and 13.6±3.4 years for group B. The difference in age at surgery was statistically significant (P<.05). Average follow-up for groups A and B were 4.8 and 3.4 years, respectively.

Complications
For study purposes, complication rates are reported per hip operated. Also, the complication rate in the casted group (group A) versus the non-casted group (group B) are contrasted. Seven categories of complications were identified: skin sores, wound infections, instrumentation failure/bone problems, reoperation, rehospitalization, resubluxation/redislocation, and fractures. For each category, no statistically significant difference was noted in the complication rate between the groups. However, the
number of patients in the noncasted group was not large enough to exclude the possibility of a type II error.

Skin Sores. Forty-three (15%) skin sores were associated with casting in group A. However, hospitalization for sores was required in only three instances and did not require a surgical procedure. The remaining sores were treated by cast trimming or removal and local wound care, usually without the use of oral antibiotics. These measures led to rapid resolution of the sores and return to preoperative functional status.

Wound Infections. Eleven (4%) wound infections occurred in group A and one (3%) in group B. All but one was superficial, requiring local wound care and antibiotics. One case of deep infection occurred in group A and required surgical incision and drainage followed by antibiotics. No chronic draining wounds and no cases of osteomyelitis occurred. Whether the infections were directly related to the casts or were the result of wound inoculation at surgery is difficult to ascertain. However, the prevalence was equivalent in both groups.

Instrumentation Failure/Bone Problems. In group A, six (2%) instances of this complication occurred and zero (0%) in group B. However, three in group A involved avascular necrosis of the femoral head for which no treatment was required. One nonunion of a shelf acetabuloplasty noted radiographically occurred, but required no treatment and did not affect hip stability. A screw used to stabilize bone graft over a shelf was radiographically noted to be broken in another case, but required no treatment and did not compromise hip stability. Only in one case in which the proximal femoral fragment rotated around the implant was reoperation needed. In this case, the displaced fragments underwent open reduction and the internal fixation was revised. This complication, although occurring in group A, was due to poor fixation technique during the index operation and not the result of being in a cast.

Reoperation. Twenty-two (8%) reoperations occurred in group A and one (3%) in group B. However, aside from one reoperation for an infection and one for instrumentation failure in group A, all other reoperations were performed for persistent or recurrent hip subluxation/dislocation. Reoperations consisted of procedures to stabilize the hips or improve limb position.

Rehospitalization. Thirteen (5%) rehospitalizations occurred in group A and one (3%) in group B. Only three were due to sores. Four were related to casts that needed removal, replacement, or both. The remaining rehospitalizations were for other reasons. The one group B patient was readmitted for physical therapy because of difficulty regaining functional range of motion of the operated hip.

Resubluxation/Redislocation. Thirty-eight (13%) hips in group A and I (3%) in group B suffered this complication. The resubluxation in group B underwent reoperation. However, in group A, 18 of the 38 affected hips were not treated surgically for a variety of reasons. The others went on to reoperation to stabilize the hip or improve motion and position of the affected limb.

Fractures. Eleven (4%) leg fractures occurred after cast removal in group A. No fracture required surgical treatment and all except one healed with minimal treatment using external immobilization with a cast or splint. The exception was a fracture that had healed by the time it was recognized.

**DISCUSSION**

Casting after hip reconstructive surgery in cerebral palsy patients is a common and accepted practice. However, in reviewing the literature, few complications are associated with casting itself. Airt et al reported no complications in their series of 17 hips. Brunner and Baumann, who casted their patients for 6 weeks postoperatively, reported 3 femur fractures after cast removal and 1 deep infection. However, hardware failure or infection was not mentioned.

Gordon et al reported 2 skin sores from casts but no hardware failure or infections in 52 hips. McNeerney et al, in a series of 104 hips, noted no hardware failure or sores but reported 1 superficial and 2 deep infections, and 8 hips developed avascular necrosis. In an earlier series, the same senior authors reported no hardware failure, sores, or infections in a series of 18 hips. However, 2 hips developed avascular necrosis.

Pope et al reported 23 hips and the only complication mentioned was a protruding pin. In a series of 35 hips immobilized for 6 weeks in a spica cast, Root et al reported no infections or cast sores but 8 hips developed avascular necrosis. Shen et al noted no cast sores, infections, or avascular necrosis.

In a series of 55 hips, Song and Carroll reported 2 cases of hardware failure and 1 case of avascular necrosis as well as 10 fractures (7 femur and 3 tibia) after cast removal, but no cast sores.

Stasikelas et al had a 17% fracture rate (25 in 16 patients) and a 3% rate (5 patients) of pressure sores in a series of 110 hips. Hardware failure or infection was not reported.

Finally, Zuckerman et al, who used postoperative spica casts for 6 weeks, reported a supracondylar femur fracture as the only complication. Thus, from the literature review as well as the data from the present study, it seems that complications associated with casting (eg, fractures after cast removal, pressure sores, and wound infections) have a relatively low occurrence. Few hardware failures were noted, which casting often is assumed to be protective against.

Only 2 series reviewed routinely used no postoperative immobilization. The first was in a series of 70 hips by Miller et al and the second a series of 145 hips by Miller (written communication, 2000). These authors used a protocol of "positioning for comfort" for the first 1 or 2 days postoperatively after which patients underwent range of motion exercises and were allowed to sit. These activities were done using analgesics and muscle relaxants to control discomfort and spasms. However,
despite not having an overlying cast, skin breakdown occurred over 6 plates such that the metal was exposed. These wounds were allowed to granulate over. Two deep and 1 superficial wound infections and 4 probable avascular necroses were noted. Three fractures occurred: 1 after plate removal, 1 when a child twisted his operated leg, and 1 in a child who required a cast because of instability of the operated hip. Hardware failure was not mentioned.

These authors claim a high degree of patient/parent/caretaker satisfaction with this no-cast approach. Some who had previously cared for a child in a cast stated that they preferred this approach at a subsequent hip operation.

The majority of casted patients, such as those of Miller et al. and Miller (written communication, 2000), were younger and more severely affected by cerebral palsy with significant spasticity. It is difficult to imagine how these children can be managed without casts or at least some kind of leg immobilization to prevent them from drawing up their painful operated legs, which can contribute to the development of flexion contractures. Some children who were managed without casts had pain issues with every movement of their operated limbs during the immediate postoperative period. A single-shot caudal block helps with pain and spasm but dissipates in 4-6 hours. A continuous epidural can be placed, but for how long?

The caretaker must be diligent in handling and positioning non-casted patients to avoid undue forces on the freshly fixed osteotomies lest they become disrupted. Wound breakdown over the blade plates was not reported in our series with overlying casts but was reported by Miller et al. and Miller (written communication, 2000). Why did this breakdown occur? Were the children lying on the wounds putting pressure over the hardware, which may have been particularly prominent? Was wound healing a problem because of nutritional deficits? Were there really no hardware failures?

Most patients are spastic and cannot control their leg position. Postoperative pain is exacerbated by muscle spasms and movement of the operated limbs. Casting protects and maintains a more normal position of the operated limbs. It is arguable whether immobilization makes spasms worse because the limbs are encased in the cast and cannot move. It would seem reasonable to assume that holding the limbs in a comfortable position and preventing movement would actually prevent spasms compared to allowing the limbs to move voluntarily. Pain management is not hindered even with a spica cast. The usual continuous or patient-controlled intravenous analgesia is used commonly in these patients. In addition, single-shot or indwelling catheter epidural analgesia can be used as well.

Immobilizing operated hips in neutral flexion/extension with mild abduction allows wound healing, prevents flexion contractures, and permits a more anatomic and clear assessment of follow-up radiographs. Resolution of a hip flexion contracture, even a small one, generally is much harder than regaining flexion from the neutral position. Immobilization just until adequate healing of osteotomies is seen on radiographs keeps time in the cast to a minimum thus limiting problems of stiffness and loss of functional range of motion. A spastic postoperative child in a cast makes him or her easily portable for transport and avoids unnecessary manipulation of the operated limbs for positioning.

Although maintaining hygiene in a cast can be difficult, in the majority of patients this was not a serious problem. The caretakers are taught how to care for bowel and bladder needs, and how to apply diapers appropriately so as to minimize fecal and urinary soiling of the cast. Adequate cleaning of the perineal areas can be accomplished by cleansing with damp washcloths on a regular basis.

Skin sores occurred in 15% of casted patients; however, 85% had no skin sores. Furthermore, only three patients required readmission to resolve the sores. The remaining patients required local wound care and cast modification. Minimizing fecal and urinary soiling of the cast and underlying skin prevents sores. Changing position frequently to limit the pressure exerted over poorly padded bony prominences can also prevent them. Additionally, proper cast application plays a role in prevention as well.

Osteopenia occurs during casting, but also occurs as a consequence of an anticonvulsants and poor nutrition, both of which are common in this group and can be present before a cast is ever used. The child should be in a reasonable nutritional shape preoperatively and possibly consider the use of medications that limit bone resorption.

Osteopenia, however, does not always lead to fracture. In fact, in the present casted group, only 11 (4%) fractures occurred in 286 operated hips. Additionally, the treatment was minimal and all fractures healed without significant deformity. Although 2 hardware failures occurred in the casted group, neither could be blamed on the casts. The case of screw breakage had no consequence. The other case involved poor operative technique at the index surgery and a cast could not have prevented the displacement of the bony fragments due to poor surgical execution. The other complication categories such as rehospitalization, resubluxation/redislocation, and reoperation were seen in both groups and, aside from the rehospitalizations associated with skin sores, the remaining complications had no relation to being in a cast.

Authors who advocate the no cast technique indicate that patients/parents demand that casts not be used and that allowing the proposed surgery may be contingent on not using a cast. Interestingly, none of the parents in this series made such demands. In fact, many of the parents wanted their children to be in casts. They felt safer moving the children around in casts and avoiding injury to the operated limbs.

**Conclusion**

Although the casted hips had a
somewhat numerically higher absolute complication rate than those not casted in this series, those rates were still low and the differences were not statistically significant. The casted patients tended to be younger, usually more severely involved neurologically, and may have had poorer nutritional status than those not casted. Treatment of problems directly related to casts, such as skin sores and fractures, was simple and effective, and resolved the problems promptly without sequela. The complication rate in the present study compares favorably to other reported series.

Although a "no cast" approach may be reasonable in this group, postoperative casting has a low complication rate and is a useful technique to ensure healing of osteotomies, preventing instrumentation/bone interface failure, and allowing ease of handling in this difficult patient population. Attention to detail regarding cast application as well as cast care procedures minimizes cast-related problems.

REFERENCES

EDITORIAL DISCUSSION
ORTHOPEDICS: Do you have any specific recommendations regarding pain management postoperatively?
Lubicky et al: Typically, the more severe children are placed on continuous morphine supplemented with the PCA, which can be provided by the parent, nurse, or patient. Additionally, a number of patients receive either "one shot" or continuous epidural analgesia postoperatively. The continuous variety is continued for several days postoperatively. Additionally, appropriate muscle relaxants are administered parenterally or orally to provide additional comfort. Patients are switched to oral medications as soon as possible because of frequent problems with nausea and vomiting caused by the parenteral analgesics.

ORTHOPEDICS: Is a compromise in postoperative immobilization worthwhile?
Lubicky et al: We have done all or nothing for the most part. We have not used removable hip splints but prefer to leave the spica cast on for 6 weeks. Occasionally, the cast needs to be removed prior to the end of that time because of soiling in which case we use a splint. Few cast problems occur and once the child's initial postoperative pain has resolved problems with spasms or pain are limited. Because most patients do not have hygiene problems, the cast does not need to be removed.