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Original Research

Weight Percentile Is Maintained During Spica Casting: A Retrospective Cohort Study of Patients Treated with Closed or Open Reduction for Developmental Dysplasia of the Hip

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ABSTRACT

Background: Weight changes during spica casting previously have not been reported. The primary aim of this study was to determine weight percentile change from cast initiation to cast removal. Secondary aims were to assess weight percentile changes from initiation to mid-term follow-up visits after cast removal and to assess the mean weight change from cast initiation to cast removal.

Methods: Patients with developmental dysplasia of the hip (DDH) treated with closed or open reduction (± femoral/pelvic osteotomy) and spica cast were retrospectively reviewed from 2/2016–6/2023. Patients aged <4 years treated for ≥6 weeks in spica cast were included. Patients lacking weight measurements within the 4 weeks prior to cast initiation or within 2 weeks following cast removal were excluded. Demographics, weight, and weight percentiles at cast initiation, cast removal, and at follow-ups were collected. Mean weights and mean weight percentiles were compared across visits with dependent sample *t*-tests and one-way analysis of variance tests based on normality, with a significance threshold of $P \leq .05$.

Results: Thirty-six hips in 31 infants (median age: 10.4 [interquartile range {IQR}: 9, 16.3] months, 86% female) were included. The median duration of casting was 9.2 [IQR: 7.9, 12.6] weeks; 2 hips had midpoint cast change. The mean weight was 9.8 ± 2.3 kg at cast initiation and 10.1 ± 1.9 kg at final cast removal, with a mean change of 0.3 ± 0.4 kg ($P = .527$). Mean weight percentiles did not differ during or after treatment (range: 55-61st percentile, $P = .974$).

Conclusion: Weight percentiles were maintained during spica casting in the patients examined in this study, which should be reassuring to the family and treatment team; our study did not find that spica casting stunts weight gain. For surgeons who may consider maintaining the original spica cast throughout treatment, without cast change, a mean weight gain of 0.3 kg for a mean casting length of 9 weeks in infants of median age 10.4 months should be reassuring; many infants/toddlers may not require a cast change due to growth.

Key Concepts:

(1) Spica casting does not appear to stunt weight gain.
(2) The weight percentile did not change during spica casting following open or closed reduction for developmental dysplasia of the hip.
(3) The mean weight gain during typical spica casting is 0.3 kg, which was not statistically significant.

Level of Evidence: III, retrospective cohort

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Introduction

Spica cast immobilization is the current standard technique of immobilization following closed or open hip reduction for developmental dysplasia of the hip (DDH) in infants and toddlers [1–4]. Patients typically remain in the cast for 6–12 weeks postoperatively [5], or longer, should they require bilateral hip surgery. Surgeon preferences vary, but standard treatment includes intermittent evaluation of the hips post procedure. Some patients undergo a cast change with an exam under anesthesia with or without arthrogram, whereas others evaluate the hips in the spica with magnetic resonance imaging or plain radiographs [6].

Infants gain approximately 20 g per day between three and six months of age [7,8]. Between six and twelve months, infants gain approximately 10 g per day [7,8]. Between one and two years, the weight gain slows to approximately 5.5 g per day. This rate is maintained after 2 years of age [9]. Although weight percentiles may vary slightly within the first year of life [10], a deceleration of weight across two major percentiles is typically the threshold at which undernutrition and failure to thrive are diagnosed [11]. Limited prior literature about weight percentile change in healthy children shows that as children grow older, the change in weight percentile is less common over time [11,12]. One study found that 39% of children under 6 months of age crossed two major weight-for-age percentiles, but by the age of 2 years, only 5% of children crossed two weight-for-age percentiles (percentiles defined as 5th, 10th, 25th, 50th, 75th, 90th, and 95th) [11].

No study to date has specifically examined weight change during spica casting. Such information is valuable to providers in that weight changes during spica cast treatment may prompt additional observation and/or nutritional interventions, whereas weight maintenance may be communicated to parents of patients with DDH to provide ease of mind. The primary aim of this study was to determine the weight percentile change from cast initiation till cast removal. The secondary aims were to assess weight percentile changes from initiation till further follow-up following cast removal and to assess the mean weight change from cast initiation till cast removal and further follow-up.

Materials and methods

A retrospective cohort study was performed at a single urban tertiary care orthopaedic hospital from 2/1/2016 to 6/1/2023. Patients were identified via the International Classification of Diseases (ICD-10) codes for DDH and were included if they were less than 4 years of age at treatment, underwent open or closed hip reduction with/without femoral or pelvic osteotomy, and were treated for a minimum of 6 weeks in the spica cast postoperatively. Patients were excluded if they were missing weight measurements within 4 weeks prior to cast initiation or within 2 weeks of cast removal (Fig. 1).

Data extracted included demographics (age, sex, race, and ethnicity), patient weight at spica cast initiation and removal, and patient weight at each follow-up visit. Follow-up weights were grouped into 1- to 3-month, 4- to 6-month, 6- to 9- month, and 9- to 12-month blocks due to variations in follow-up intervals within the cohort. The same calibrated scale (Acme Medical, San Leandro, CA) was used to weigh patients at each timepoint as part of routine standard of clinical care. Patient weights were converted to percentiles using the World Health Organization data if not available directly from the patient charts [13]. Major weight percentiles were defined as 5th, 10th, 25th, 50th, 75th, 90th, and 95th [11]. Categorical variables were described as percentages. Continuous variables were reported as means (standard deviation [SD]) or medians (interquartile range [IQR]) based on normality as assessed by Shapiro–Wilk tests. Analysis was conducted by hip due to differing lengths of spica cast treatment between hips in patients with bilateral dysplasia. Change in mean weight was compared with dependent sample *t*-tests and one-way analysis of variance testing based on normality. Change in mean weight percentile overtime was compared with dependent sample *t*-tests and one-way analysis of variance testing. Statistical analysis was performed

Table 1
Demographics and treatment characteristics.

Demographics	***N* = 36 hips**
Median age at start of treatment (months) (median [IQR])	10.4 (9, 16.3)
Sex	
Female, n (%)	31 (86)
Male, n (%)	5 (14)
Race/ethnicity, *n* (%)	
White	23 (64)
Black or African American	0 (0)
Asian	5 (14)
Other	3 (8)
Declined/unknown	5 (14)
Ethnicity, *n* (%)	
Not Hispanic or Latino	29 (81)
Hispanic or Latino	2 (5)
Declined/Unknown	5 (14)
Laterality of treated hip, *n* (%)	
Left	22 (61)
Right	14 (39)
Surgical Procedure, *n* (%)	
Closed reduction same cast throughout	14 (39)
Closed reduction with midpoint cast change	2 (5)
Open reduction with same cast throughout	15 (42)
Open reduction with pelvic osteotomy	5 (14)
Median weeks in cast (median [IQR])	9.7 (7.9, 12.6)
Mean weight at time of cast application, kg (mean ± SD)	9.8 ± 2.3

IQR, interquartile range.

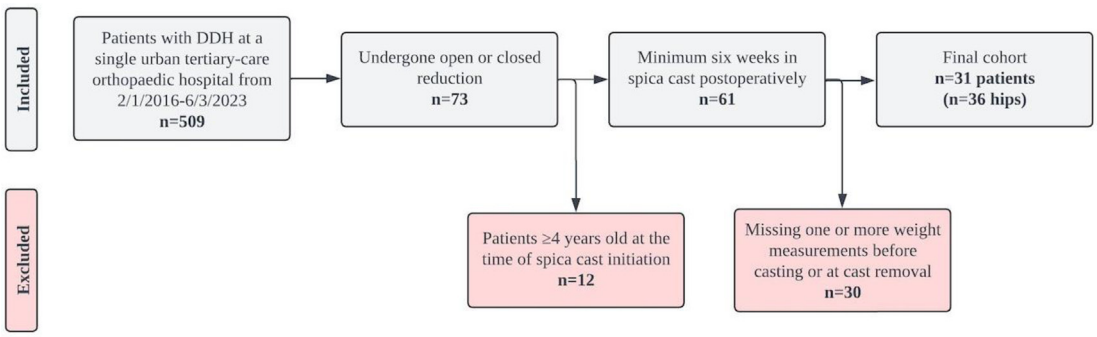

Figure 1. Flow diagram of inclusion and exclusion criteria. DDH, developmental dysplasia of the hip; n, number of patients (unless specified).

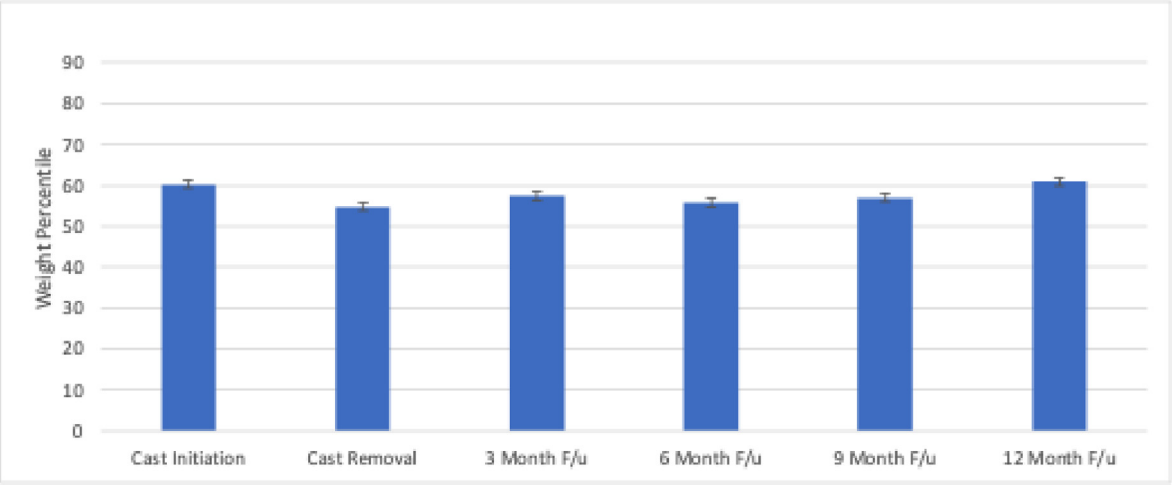

Figure 2. Change in patient weight percentile. Weight percentile did not significantly change at any point when compared to cast initiation. Kg, kilograms; F/u, follow-up.

using SPSS Statistical Analysis Software, Version 29 (IBM, Armonk, NY, USA), with significance threshold set as $P \leq .05$.

Results

A total of 509 infants underwent treatment for DDH, of whom 73 underwent operative intervention (open/closed reduction and/or osteotomy) and spica cast application. Patients were excluded as listed in Fig. 1. Thirty-six hips (in 31 patients) were included, with demographics presented in Table 1. Sixteen hips underwent closed reduction alone, 15 hips underwent open reduction alone, and 5 hips underwent open reduction with pelvic osteotomy. The median duration of casting was 9.7 [IQR: 7.9, 12.6] weeks. Thirty-four hips had a single cast with a median duration of 9.2 [IQR: 7.9, 12.6] weeks. Two hips had a cast change due to planned staged procedure for bilateral DDH.

The median age at treatment was 10.4 (IQR: 9, 16.3) months. The mean weight was 9.8 ± 2.3 kg at cast initiation and 10.1 ± 1.9 kg at cast removal, with a mean weight change during casting of 0.3 ± 0.4 kg (P = .527). The mean weight percentile was 60th at cast initiation (n = 36 hips), 55th at cast removal (n = 36), 57th at 1-3 months post cast removal (n = 48), 56th at 4-6 months post cast removal (n = 20), 57th at 6-9 months post cast removal (n = 16), and 61st at 9-12 months post cast removal (n = 14). Seven of 36 (19%) patients crossed 2 major weight-for-age percentiles during cast treatment (6 decreased by 2 major percentiles, 1 increased by 2 major percentiles). However, mean weight percentiles did not significantly differ over the course of treatment (P = .974) (Fig. 2).

Discussion

The purpose of this study was to assess how weight may change during and after spica casting following treatment of DDH. The mean weight gain was 0.3 kg during a mean casting length of 9.8 weeks, and weight percentiles were maintained over the treatment course and thereafter.

No study has assessed weight change during spica casting. Prior studies have noted insignificant weight change following orthopaedic procedures in normal–body mass index adult populations [14,15], in contrast with significant postoperative weight gain in overweight adult populations [16–18]. A study noted postoperative weight gain in adolescents post anterior cruciate ligament reconstruction [19]. Many families inquire on what to expect regarding weight changes during casting. Until now, clinicians made estimates but did not have concrete data to counsel families. Spica cast treatment does not appear to have short-term or mid-term effects on weight percentiles; weight gain was not stunted in our study by spica cast treatment. Nonetheless, the casts are typically applied for a short-enough period of time that the average patient gains 0.3 kg and cast overgrowth may not be anticipated with modern cast application techniques. This preliminary data may be utilized to reassure parents of patients with DDH that spica casting should not significantly impact weight percentiles over the course of treatment.

This study has several limitations. First, the study included a relatively small sample size; a number of potentially eligible patients were excluded due to missing datapoints. While 509 patients were initially screened, only 31 were included due to strict inclusion criteria. Larger prospective cohort studies may be necessary to detect potential changes in weight. Second, patients were treated at a single tertiary care urban orthopaedic hospital; results of this population may not be generalizable to other facilities using different casting techniques to other populations. Third, retrospective chart review was limited by the quality of information recorded for clinical purposes. Finally, the study design did not include a control group; however, weight percentiles were selected as an outcome measure for standardization of weights, given a range of ages included in the study from 3 months to 4 years at initiation of treatment.

Conclusions

In infants and children treated with spica casting for DDH, there were no significant short-term or mid-term effects on weight. Anticipated weight gain for 10 weeks of casting for a 6- to 12-month-old is 0.7 kg, and for patients older than 12 months, it would be 0.35 kg. The actual weight gain in this study was of 0.3 kg for a mean casting of 9.8 weeks for infants of median age 10.4 months. Weight gain appears to be small enough due to relatively short durations in cast and anticipated weight gain at typical treatment ages that cast overgrowth may not be expected. Although weight may rarely be the cause of cast change during spica treatment, care must be individualized and cast changes may be implemented in any given patient for overgrowth, hygiene, to allow interval hip examination in the operating room, to change the limb position in cast, or for other clinical purposes.

Consent for publication

The author(s) declare that no patient consent was necessary as no images or identifying information are included in the article.

Ethics approval and consent

This study was approved by the Hospital for Special Surgery Institutional Review Board (IRB #2023-0931) on 06/12/2023. This study required no patient consent as it is a retrospective review.

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Author contributions

Olivia C. Tracey: Writing – review & editing, Writing – original draft, Methodology, Investigation, Formal analysis, Data curation. **Kiranpreet Nagra:** Writing – review & editing, Writing – original draft, Investigation, Formal analysis, Data curation, Conceptualization. **Keza Levine:** Writing – review & editing, Writing – original draft, Formal analysis, Data curation. **Akshitha Adhiyaman:** Writing – review & editing, Writing – original draft, Methodology, Formal analysis, Data curation. **Paige McBoyle:** Writing – review & editing, Methodology, Investigation, Data curation. **Erikson Nichols:** Writing – review & editing, Writing – original draft, Methodology, Formal analysis, Data curation, Conceptualization. **Melanie Prior:** Writing – review & editing, Writing – original draft, Supervision, Methodology, Data curation, Conceptualization. **Ernest L. Sink:** Writing – review & editing, Writing – original draft, Supervision, Methodology, Conceptualization. **David Scher:** Writing – review & editing, Supervision, Methodology, Investigation, Conceptualization. **Shevaun M. Doyle:** Writing – review & editing, Writing – original draft, Supervision, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Emily Dodwell:** Writing – review & editing, Supervision, Methodology, Investigation, Conceptualization.

Declaration of competing interests

The authors have no relevant disclosures.

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