

# In-toeing and out-toeing gait conservative treatment; hip anteversion and retroversion: 10-year follow-up

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**Background:** In-toeing and out-toeing rotational deformities are among the most common referrals for consultation with orthopedic specialists. Although a few number of patients need surgical interventions, most of them get better spontaneously without major complications in adult life. In this study, we investigated the prevalence of permanent gait deformities due to hip rotational disorders in a group of patients who underwent conservative treatments. **Materials and Methods:** This retrospective cohort study was conducted in the orthopedic department on patients with rotational deformities of the lower extremities (hip anteversion and hip retroversion). From 2,983 patients, 611 were included in this study and followed up for 10 years. Medial rotation of the hip, lateral rotation of the hip, and tibia fibula angle (TFA) of each patient were measured independently. **Results:** In this study, 611 patients were assessed and 323 (143 male and 180 female) were followed up in our study. Two hundred and seventy patients had in-toeing gait disorders due to hip anteversion, which 178 of them were corrected conservatively (%). Furthermore, among 53 patients with out-toed gait due to hip retroversion, 44 patients (%) were corrected in the same conditions ( $P = 0.001$ ). It was determined that gait disorders were corrected conservatively in 102 of 143 males and 120 of 180 females ( $P = 0.37$ ). **Conclusion:** Our findings showed that rotational deformities are expected to be corrected by conservative management. It is better to consider surgical procedures as the last therapeutic option.

**Key words:** Hip anteversion, hip retroversion, in-toeing gait, out-toeing gait, tibia fibula angle (TFA)

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## INTRODUCTION

Rotational deformities of the lower extremities called by parents as “in-toeing” (metatarsus adductus, internal tibial torsion, and femoral anteversion) and “out-toeing” patterns (external rotation hip contracture, external rotation of the tibia, and external rotation of femur) are among the most common referrals for consultation with pediatric orthopedic specialists.<sup>[1-4]</sup> Various underlying pathologies are responsible for such disorders.<sup>[5]</sup> Parental concerns about whether these rotational deformities will influence the growth and aesthetic gait pattern of their children may lead to these referrals.<sup>[5]</sup> While a

few number of lower extremity rotational variations in pediatrics need surgical interventions or conservative treatments such as postural exercises, wedge shoes, brace, stretching and splints, most of them are benign and resolve spontaneously over time without any major restriction in adult life.<sup>[2,6-8]</sup> Considering medical costs and the high psychical burden of surgeries in children, it would stand to be reason then that understanding the normal variations in healthy children is essential.<sup>[9]</sup> Evidences about conservative or surgical management of a child with such deformities and also their outcomes are limited. In this study we investigated the prevalence of permanent gait deformities due to hip rotational disorders in a group of patients who underwent conservative treatments.

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## PATIENTS AND METHODS

This retrospective cohort study was conducted in the orthopedic department on patients with rotational deformities of the lower extremities (hip anteversion and hip retroversion). From 2,983 patients, 611 were included in this study and followed up for 10 years. Medial rotation of hip, lateral rotation of the hip, and tibia fibula angle (TFA) of each patient were measured independently.

Participants were included in our study according to the result of our previous study,<sup>[10]</sup> which had been performed at the Orthopedic Department of Kashani Hospital (a tertiary care referral center), Isfahan, Iran. In our last study, participants were asked to walk on the paper while their feet were covered with ink (at least two steps). Then we drew two lines on the marked paper: One line parallel to the direction of the patient walking and the second one between the lateral side of the second finger to the center of the heel, which crossed the first line. The angle between these lines was measured and called foot progression angle (FPA). If this angle was less than 3°, we considered it to be in-toeing gait and if it was more than 20°, we considered it to be out-toeing gait.<sup>[10]</sup>

In our study, 611 of the 2,983 kids had rotational deformities of the lower extremities.<sup>[10]</sup> All patients with in-toeing gait and out-toeing gait disorders were referred to our orthopedic clinic. Two expert orthopedists measured medial rotation of hip (MRH), lateral rotation of hip (LRH), and TFA of each patient independently after a 10-year follow-up. In cases of nonconsensus, a third independent orthopedist was obtained.

MRH and LRH were measured with the patients lying in the prone position; the pelvis was fixed, the knees were bent at a 90° angle, and then the shanks were turned inward and outward. In the patients with in-toeing gait; if the hip internally rotated more than 50° in males and 40° in females we were considered it to be hip anteversion and in the patients with out-toeing gait if the hip externally rotated more than 45° for both the sexes we considered it to be hip retroversion (rotation angles were measured by a goniometer).<sup>[11]</sup> For measuring TFA angle, patients were placed in a semi-standing position on their knees such that their knees were bent at 90° and the shanks were parallel to each other. Then the angle between the longitudinal axis of the leg and the longitudinal axis of the thigh was measured.

Patients who had lower extremity disorders because of hip rotational deformity (hip anteversion and hip retroversion) were selected for the study. Any patient who had neurological disease (Charcot-Marie-Tooth, cerebral

palsy), inflammatory disease, trauma (which had led to fracture of the lower limb), osseous malformation, or other deformities (rotation of the tibia, rotation of foot, etc.) was excluded. Furthermore, those who had moved out of the area, could not be traced, or had passed away were excluded from the study.<sup>[12]</sup>

All of our participants had been treated conservatively with means such as braces, medical shoes, or without any intervention.

Information was collected only after the patient gave his/her informed consent and was approved by the Research Ethics Board of Isfahan University of Medical Sciences to participate in this study.

### Statistical analysis

All statistical analysis was performed using SPSS version 22 (SPSS Inc., Chicago, IL, USA). The chi-square test was used to assess the association between two or more nominal variables. The probability of a difference between the two groups was assessed with a *t*-test for independent samples. All tests were two-tailed, and a *P* value of <0.05 was considered as the significance threshold.

## RESULTS

In this study, 611 patients were assessed. Of them, 288 were excluded due to the exclusion criteria and 323 (143 males and 180 females) were enrolled in our study; all of them had hip rotational disorders (hip anteversion and retroversion). Participants had no surgical procedure due to gait disorders treatment. The mean [standard deviation (SD)] of TFA in all participants were 7.03 ± 7.74 and the mean of LRH was 39.98 ± 0.97. Two hundred and seventy patients had in-toeing gait disorders due to hip anteversion, which 178 of them (65.9%) corrected conservatively. Furthermore, among 53 patients with out-toed gait due to hip retroversion, 44 patients (88%) were corrected in the same conditions [Table 1]. Chi-square test showed a significant difference between these two groups (*P* = 0.001). It was determined that gait disorders were corrected conservatively in 102 of 143 males (71.3%) and 120 of 180 females (66%). Independent *t*-test showed no significant difference between sex and gait disorders correction (*P* = 0.37).

The mean age of patients whose gait disorders were corrected with conservative treatment and those with

**Table 1: The results are presented in numbers (%)**

Gait disorder	Corrected	Not corrected	<i>P</i> value
Patients with out-toeing gait	44 (88)	9 (12)	0.001
Patients with in-toeing gait	178 (65.9)	92 (34.1)	
Total	222	101	

persistent disorders after a 10-year follow-up was  $17.3 \pm 1.5$  and  $17.6 \pm 1.7$ , respectively. Independent *t*-test showed no significant difference between correction of gait disorders and the average age of the patients ( $P = 0.18$ ). More details are as presented in Table 2.

## DISCUSSION

Despite the high prevalence of pediatric in-toed and out-toed gait patterns, the studies are limited and sparse, which may lead the clinical management of these patients interpreted with caution.<sup>[11,13-15]</sup> To the best of our knowledge, there is limited evidence about the outcome of nonsurgical management in these patients.<sup>[5]</sup> Therefore, the aim of this study review was to identify the effect of conservative treatment on patients with lower extremity rotational disorders within a 10-year follow-up in a pediatric population.

It was shown by the result of our study that in the long-term follow-up of patients, their gait disorders were corrected mostly by conservative treatment. Furthermore, out-toeing gait disorders were corrected more significantly by conservative treatment than in-toed gait patterns.

Our findings were in line with a previous study conducted by Kamegaya *et al.* in Japan, where after a 6-year follow-up in 177 patients with in-toeing gait disorders, only 1% were faced with worsened walking position and 6% with an unchanged walking pattern.<sup>[16]</sup>

In our study, there was no correlation between the increasing age of patients and correction of gait disorders. In contrast, Pikow *et al.* showed a lower prevalence of rotational deformity in the lower extremity in older patients. It should be mentioned that our patients were age range was 15-20 years while in the Pikow study, age of the patients who were assessed from birth to 10 years.<sup>[17]</sup> We believe that at a higher age, the correction of gait rotational disorders is less probable. However, more studies need to be done to shed more light on the effect of age on correction of gait rotational disorders.

**Table 2: Mean (SD) age of patients with gait disorders after a 10-year follow-up with respect to gender**

Age	Number of girls (%)		Number of boys (%)	
	Corrected	Not corrected	Corrected	Not corrected
15 years	12 (52.18)	11 (47.82)	17 (80.95)	4 (19.05)
16 years	36 (81.82)	8 (18.18)	19 (70.37)	8 (29.63)
17 years	9 (50)	9 (50)	11 (68.75)	5 (31.25)
18 years	37 (72.55)	14 (27.45)	29 (78.38)	8 (21.62)
19 years	18 (64.29)	10 (35.71)	15 (65.22)	8 (34.78)
20 years	8 (50)	8 (50)	11 (57.89)	8 (42.11)
Total		180		143

Future studies with admissible sample size and robust methodological design are suggested to focus on the underlying pathology driving the gait disorders in patients in whom the gait disorders will not be corrected after a long-term follow-up by a nonsurgical management.

## CONCLUSION

Our findings showed that rotational deformities and especially external forms are highly expected to be corrected by conservative management. It is better to consider surgical procedures as the last therapeutic option for patients.

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Nil.

### Conflicts of interest

There are no conflicts of interest.

## AUTHOR'S CONTRIBUTION

MHN contributed to the conception of the work ,conducting the study, revising the draft, approving the final version of the manuscript, and agreeing with all aspects of the work. BF contributed to the conception of the work, revising the draft, approving the final version of the manuscript, and agreeing with all aspects of the work. AMR contributed to the conception of the work, approving the final version of the manuscript and agreeing with all aspects of the work.

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