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Research Article

Current Management of Idiopathic Toe-Walking Gait in Children and Young People in the UK: A Cross-Sectional Survey to Reflect Physiotherapists' and Surgeons' Perspective

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Abstract

Objectives: The aim of this study is to understand current practice in the referral, management and treatment of idiopathic toe-walking gait in children in the UK

Design: A cross-sectional survey design was utilised to collect data from paediatric physiotherapists and orthopaedic surgeons.

Setting: Data were collected from UK-based members of the Association of Paediatric Chartered Physiotherapists and British Society of Children's Orthopaedic Surgeons

Participants: Three hundred and ninety-one paediatric physiotherapists and forty-two surgeons participated in the survey.

Outcome Measures: An online questionnaire consisting of twenty-six questions covering topics including demographics and practice setting, surgical, physiotherapy, orthotic and serial-casting interventions was distributed.

Results: Health professionals representing all geographical regions of the UK responded to the survey. Results describe variability in entry points to services and in health professionals and practice settings involved in the delivery. Although physical impairment remains a primary indicator for intervention, social and emotional function and success of previous intervention were important factors. Physiotherapy intervention remains a mainstay of treatment and assessment, despite a paucity of evidence in its favour. Defining the role of the orthopaedic surgeon in delivering effective treatment for longterm outcomes remains vital. Orthotics and serial casting were frequently offered as adjuncts to other interventions. The need for standardised pathways of care was recognised.

Conclusions: Significant heterogeneity was identified in the management of children with idiopathic toe-walking gait within the UK. Further research to consider efficacy of surgical and non-surgical interventions both in combination and in isolation is recommended as well as developing a standardised pathway of care.

Keywords: Idiopathic toe walking; Management; orthopaedics; Survey

Introduction

Idiopathic Toe-Walking (ITW) is a term used to describe healthy children who persistently walk on their toes after the time at which they would typically achieve a heel-toe gait pattern [1]. ITW is thought to affect approximately 5% of healthy children, and is observed in both sexes. [2,3] ITW can be associated with achilles contracture and persist into adolescence and beyond [4,5], Toe-walking may be detrimental to a child and can cause calf pain, tripping and falling among other symptoms [6,7] Due to concerns about symptoms and functional impairment, children who exhibit ITW are often referred to health professionals for evaluation and treatment. Numerous interventions have been proposed in the literature including physiotherapy intervention, orthotic intervention, botulinum toxin injections, serial casting and surgery. [8] Despite the treatment of ITW being commonplace, the precise aims of, and indications for treatment are poorly understood and management varies significantly amongst health care professions and practice settings. [9] Disparity in diagnostic procedures, inconsistency in treatment options and uncertainty regarding likely success are all cited as factors negatively impacting the experiences of children who toe walk and their toes and their families [10]. Indeed the body of evidence to support specific surgical and non-surgical treatment techniques for ITW is currently limited [1,11].

There are no current recognised standards in the treatment and management of children with ITW gait in the UK [1]. Some evidence would suggest marked heterogeneity in the evaluation and treatment of ITW across parts of the western world [9] In the UK, it remains unclear how ITW in childhood is managed and by whom. This information is critical to establish standardised and equitable pathways of care and to guide empirical research capable of addressing ongoing gaps in the evidence base.

As such the goal of this study was to get a better understanding of UK-wide practice in the treatment of ITW in children. The following questions were of particular importance:

a) Who is involved in the management of ITW?

b) What is the patient journey?

c) What are the indications for treatment?

d) Which treatments are offered and when?

Materials and Methods

Study Design

A descriptive observational study was conducted using a cross-sectional survey design. Surveys were distributed to members of two key professional bodies responsible for the assessment and treatment delivery of ITW gait.

Survey Instrument

An online survey was created and piloted in the Yorkshire and East Midlands region and subsequently refined. This involved improving clarity, allowing respondents to skip sections not relevant to practice and including further detail in the section on surgical management. The survey comprised 26 questions and completion took approximately six minutes. Questions covered five sections including professional background / services, surgical, physiotherapy, orthotic and serial casting interventions. Topics were prioritised according to recent review articles [1,8,12]. Some questions allowed the selection of multiple responses (i.e. all that apply). The complete survey can be found in appendix 1.

Surveyed Population

Members of British Society of Children's Orthopaedic Surgery (BSCOS) and Association of Paediatric Chartered Physiotherapists (APCP) were invited to participate through email, online newsletter and social media. There are no current data available on the proportion of orthopaedic surgeons or physiotherapists involved in the care of children with ITW in the UK. It is anticipated only a proportion of the members from the surveyed organisations are involved. As such, a lower-than-average response rate was considered acceptable. The survey was emailed to 268 BSCOS members on the current mailing list on 9th February 2022 and re-circulated on 12th March 2022. It was circulated to

2201 recipients from the APCP mailing list on February 14th 2022 and recirculated on March 10th 2022. Links to the survey were also shared through social media platforms. Participants could only complete the survey once.

Data Analysis

Descriptive statistics were used to summarise information from closed questions and were analysed using Microsoft Excel software. Answers to question 25 were analysed using Gale's adaptation of Ritchie & Spence's Framework method [13,14]. Responses to questions were coded by JH and an analytical framework was developed. A proportion of responses (20%) were compared and contrasted by one of the senior authors and discrepancies were agreed by consensus. Themes and sub-themes were developed. Survey results were reported according to the consensus-based Checklist For Reporting of Survey Studies (CROSS) recommended by the EQUATOR network [15].

Results

A total of 435 health professionals responded to the survey. Most of the respondents were physiotherapists 391 (89.9%) or orthopaedic surgeons 42 (9.7%). Figure 1 summarises the UK regions represented within this survey.

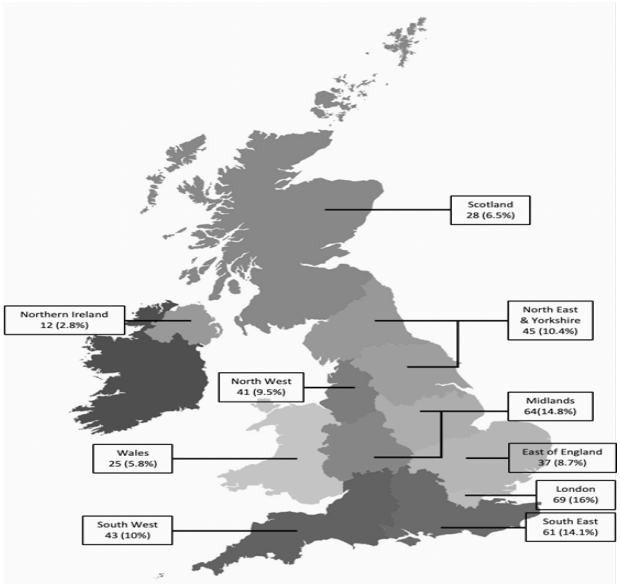

Figure 1: Regions of the UK represented in the survey. Total number of respondents 423.

Table 1 demonstrates the range of referral sources and entry points to toe-walking pathways. Results suggest that a broad range of health professional are involved in the delivery of ITW treatment (Table 1).

Sources of referral (entry points to pathway)			
	All responses (N=421) n (%)	Physiotherapists (N=378) n (%)	Orthopaedics (N=42) n (%)
Paediatrics	394 (93.6%)	354 (93.7%)	39 (92.9%)
General practice	381 (90.5%)	340 (90%)	40 (95.2%)
Orthopaedics	349 (82.9%)	324 (85.7%)	25 (59.5%)
Allied Health	315 (74.8%)	283 (74.9%)	31 (73.8%)
School Health	167 (39.7%)	163 (43.1%)	4 (9.5%)
Range of professionals involved in delivery of ITW service N = 434			
Physiotherapists		429 (98.5%)	
Orthotists		324 (74.7%)	
Orthopaedic surgeons		309 (71.2%)	
Plaster technicians		180 (41.5%)	
Podiatrists		78 (18%)	
Other (please specify)		14 (3.2%)	
Neurologist, Paediatrician, Occupational Therapist, Clinical Nurse Specialists, Radiographer, Clinical Scientist			

Table 1: Sources of referrals for children with idiopathic toe-walking and specialists involved.

Surgical Intervention

A total of 103/423 (24.4%) respondents, indicated they were involved in surgical intervention for ITW. Indications for surgical intervention as well as specific operations and post-operative protocols are summarised in Table 2. Other indications for surgical intervention cited were failure to respond to conservative management, symptomatic contracture, functional impairment and bullying. Preferred operations were percutaneous Tendo-Achilles Lengthening (TAL) and gastrocnemius muscle recession. Almost half the respondents also considered open Tendo-Achilles Lengthening (TAL) for certain cases. Post-operatively, respondents cited a preference for fully weight-bearing cast for four weeks. Nine respondents (11.7%) advised the decision for measures after surgery would be made on individual patient need. Most surgeons would carry out similar surgery on children with ASD or ADHD associated toe-walking gait (n=64, 86.5%). The primary reasons given for not considering surgical intervention for children with ASD and ADHD was concern regarding high risk of recurrence (n=4, 40%).

Preferred surgical intervention (N=74)	**n**	**Percentage**
Percutaneous tendo-achilles lengthening	52	77.5%
Muscle recession	35	65.7%
Open tendo-achilles lengthening	31	48.6%
Proximal medial gastrocnemius release	1	2.8%
Preferred immobilisation post-surgery (N=76)	n	Percentage
Four weeks	52	68.4%
Six weeks	24	31.6%
Method of immobilisation (N=75)	n	Percentage
Cast full weight-bearing	66	88.0%
Cast non-weight-bearing	9	12.0%
Measures after surgery (N=77)	n	Percentage
Physiotherapy	68	88.3%
Ankle Foot Orthosis	42	54.6%
Night-resting splint	40	52.0%
'Other'	12	15.6%

Table 2: Summary of data related to surgical intervention for idiopathic toe-walking.

Physiotherapy Intervention

A total of 376 (95.2%) respondents reported they were involved in physiotherapy interventions. Indications for physiotherapy intervention are summarised in Figure 2.

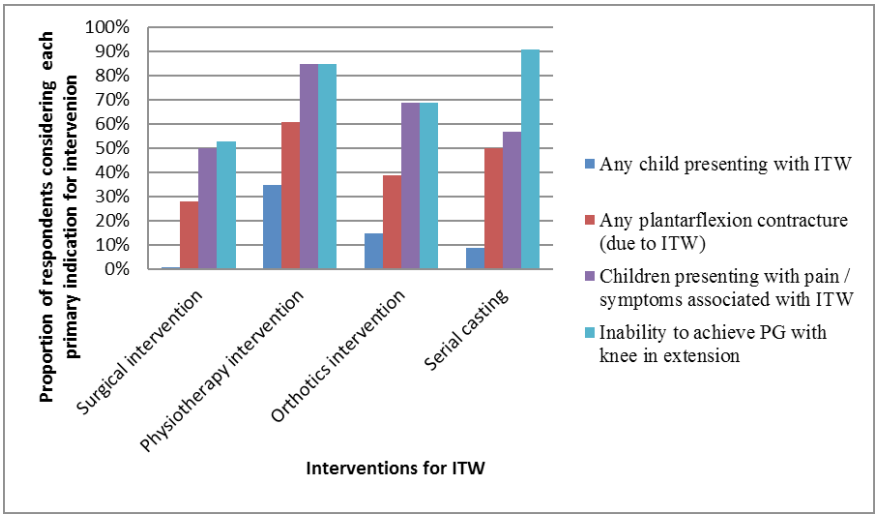

Figure 2: Summary of favoured indications for surgical, physiotherapy, orthotic and serial casting interventions for Idiopathic Toe Walking (respondents were able to select all or none of the primary indications for each intervention).

Other indications for physiotherapy intervention and/or assessment included functional difficulty, parental preference age of child, post-operative indications, assessment to rule out contributing factors, frequency of toe walking or to signpost to other services. Table 3 summarises physiotherapy interventions offered. Of the 103 respondents selecting 'other' intervention, the most common treatment was serial casting (n=97, 26.1%). Orthoses were selected by 32 respondents (8.6%), balance or core stability exercises by 13 (3.5%), and five (1.3%) suggested gait re-education.

Preferred physiotherapy intervention (N=371)	**n**	**Percentage**
Stretching exercises	366	98.7%
Education / advice	363	97.8%
Strengthening exercises	281	75.7%
Motor-sensory activities	185	49.9%
Other	129	35%

Table 3: Physiotherapy intervention for idiopathic toe-walking.

Orthotic Intervention

Three hundred and three of 388 respondents (78%) reported being involved in the delivery of orthotic intervention. Indications for orthotic intervention are summarised in Figure 2. The 'other' option, chosen by 68 respondents, included delivery with serial-casting protocol, post-operative protocol, failure to progress with other treatments (physiotherapy / serial-casting / surgery), functional impairment, high frequency of toe walking, sensory issues, instability and bullying.

Serial Casting Intervention

382 respondents stated their service was involved in serial casting. Indications for serial casting representing 279 respondents are summarised in Figure 2. The 'other' option, selected by 26, and not detailed in Figure 2, included failure to respond to other interventions, functional impairment or as an intervention prior to planned surgery. Table 4 summarises the most commonly implemented serial casting strategies. Of those selecting 'other', therapy assistants (or technicians) and nurse specialists were mentioned.

Serial casting strategy implemented (N=279)	**n**	**Proportion**
Serial casting alone	247	88.5%
Serial casting with orthoses	185	66.3%
Serial casting with botulinum toxin	60	21.5%
Serial casting with botulinum toxin & orthoses	51	18.3%
Health professionals involved in serial casting (N=279)	**n**	**Percentage**
Physiotherapist	235	84.2%
Plaster technician	151	54.1%
Orthopaedic surgeon	68	24.4%
Orthotist	56	20.1%
'Other'	21	7.5%

Table 4: Summary of data relating to serial casting interventions and the health professionals involved.

Age Range for Interventions

Preferred age ranges for all intervention are illustrated in Figure 3 with the general trend being that surgery is reserved for older children, with physiotherapy interventions spanning all ages.

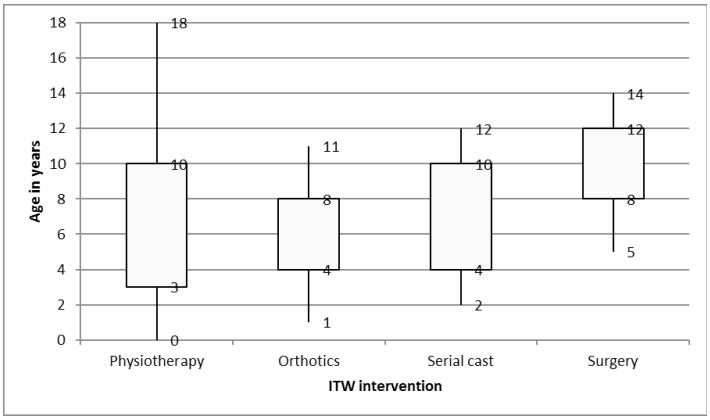

Figure 3: Box-whisker plot showing age at which interventions for Idiopathic Toe Walking are considered. Box illustrates interquartile range and whiskers show range.

Open Ended Question Responses

Four themes and 21 sub-themes identified from responses to the final question "would you like to make any other comments regarding the treatment and management of ITW gait?" are summarised in Table 5.

Themes	Evidence	Team work	Outcomes & indications	Treatments
	Local pathways developed	Effective MDT working	Intervention according to range	Avoid over-treating
	Consensus statement/ national guidelines needed	Issues with referral between centres / specialties	Focus on function	Start treatment early
	More research needed	Need for effective neurodevelopmental screening	Social implications	Physio as first intervention
		Ltd knowledge of management by wider MDT	Treatments ineffective (poor outcome)	Potential of motor-sensory treatments
			Patient / family expectations	Orthotics debate
				Serial casting debate
				Surgical debate
				Surgery only as effective as rehabilitation

Table 5: Themes and subthemes identified in response to open-ended question.

Quality and interpretation of the current evidence base was a common theme amongst respondents. The need for development of local pathways of care to guide treatment and management of children who exhibit ITW was also highlighted.

"We have a pathway which starts with simple treatment and increases if needed. Treatment is stepped up if the child has contractures and aim is to maintain range through growth rather than an immediate effect on [toe-walking]. Parents are given clear info regarding [treatment] aim as often it can take years to reduce [toe-walking] in a younger child and parents think as physios we have a magic cure for [toe-walking]."

Respondent 44

Other respondents referred to a need for national consensus on best practice or others acknowledged a need for further research in this area.

The second theme related to the teamwork involved in treatment of children with ITW. Respondents discussed a need for effective communication between health professionals and support from the wider multi-disciplinary team. The importance of effective screening for other causes of toe-walking prior to diagnosis and treatment was acknowledged.

The third theme related to outcomes and indication for treatment. Several respondents described escalation of ITW interventions according to range of motion. Others described how they base their intervention according to the impact of ITW on a child's physical function. Social and emotional aspects of function were also highlighted as valid outcomes and indications. Many respondents acknowledged the limitations of current treatments for children with ITW and expressed frustration at poor or inconsistent outcomes. The significance of managing parent expectations in this cohort was also discussed.

The final theme related to detail, debate and clarification of treatment options. Some respondents conveyed concern regarding over-treatment of ITW whilst others recommended intervening early to achieve optimal outcome. Several discussed desire for more research into sensory-motor treatment within non-surgical interventions. There was suggestion that surgery is only as effective as the rehabilitation offered.

Discussion

The results of this survey offer a detailed summary of the current assessment and management of ITW across UK. The key findings from this study relate to variability in patient pathways, health professionals involved in delivery of care, treatment strategies and indeed treatment philosophy. Although consensus-based guidelines are implemented in some other nations, no such guidance exists in the UK and no new guidance has been developed in the past decade. Orthopaedic surgeons and

physiotherapists accepted high proportions of referrals for children with ITW from general practice, paediatrics and/or allied health. Physiotherapists also accepted referrals from school health, health-visitors, podiatrists or self-referrals from parents. This disparity in entry points to care echoes international findings of Williams et al. (Williams, Robson et al. 2020). [10] It remains unclear whether differing referral pathways reflect the severity of toe walking or associated functional impact. Due to poor characterisation of natural history of ITW, the optimal time to intervene is unclear (Dietz, Khunsree 2012). [16] However, the range and variety of referral pathways and potential for concurrent referral are likely to result in inequalities, inefficiencies, and poor patient experience. Our results suggest a wide range of health professionals are involved in the delivery of ITW intervention, but it is not clear who the primary decision-makers are in this process.

Within the UK, current National Institute for Health and Care Excellence Clinical Knowledge Summaries suggest children who present to primary care walking on their tip toes should be referred either for community management by a physiotherapist with paediatric expertise or for specialist assessment according to their symptoms [17] High proportion of primary care referrals and young intervention ages noted in our survey, suggest physiotherapists are involved early in the patient journey in the UK. Despite physiotherapy interventions being a generally well-favoured, their efficacy for long-term outcomes in treatment of ITW is still unclear [1,11,18,19] Stretching and strengthening exercises have been used as adjuncts to other surgical and non-surgical treatments within the literature, but there are no high quality studies examining the efficacy of physiotherapy intervention for ITW gait in isolation [5,18,19]. Further studies to investigate specific indications and treatment criteria for stretching, strengthening and sensory-motor control interventions for ITW gait are recommended in concurrence with other recent reviews [11,12,19-21]. The potential value of the paediatric physiotherapist's expertise in child movement and development and childhood disability when screening children with toe-walking gait or acting as key decision-maker in their management, also requires further investigation due to implications for commissioning of services and standardised care.

Surgery as a management strategy for ITW has been demonstrated to have long-term impact on key gait kinematics and kinetics, with no adverse consequences such as pain or restriction in sport [22]. Despite this, respondents to our survey favoured non-surgical management in early childhood but considered surgical management if children or young people were unable to achieve plantigrade or had failed to respond to non-surgical management. Percutaneous TAL was the favoured surgical technique with 71.5% of respondents selecting to use this procedure. These results concur with recent studies comparing surgical techniques for a range of conditions associated with heel cord contracture [23,24]. This survey also offers new information regarding practices post-surgery. The preferred method and length of time for immobilisation following surgery was four weeks fully weight-bearing in cast. The most implemented measure after surgery was physiotherapy with Ankle Foot Orthosis (AFO) and resting splints following close behind.

Orthoses were also commonly included within treatment pathways for ITW by respondents to this survey. The primary indication for orthoses was inability to achieve plantigrade but presence of pain or symptoms followed closely behind. This concurs with the findings of Bartoletta et al. who found the use of AFOs to be the only non-surgical treatment to offer statistical improvement in clinical outcomes (range of motion and frequency of toe-walking) on follow-up (mean time 13.9 months) [11]. Serial casting was considered a favoured intervention in children unable to achieve plantigrade. Serial casting alone (i.e. without Botulinum toxin) was favoured in this survey. Interestingly Botulinum toxin injection was still implemented by a relatively high proportion of respondents, despite literature suggesting this to be ineffectual [1]. The range and diversity of health professionals involved in delivering this treatment technique and complexities in access and commissioning could have important implications for standards of care in future.

Despite existing literature favouring range of motion as the primary outcome when exploring ITW, functional issues were considered a key indicator for all four interventions for ITW by respondents to our survey and the importance of functional impact was also highlighted within qualitative responses. This reflects growing evidence of the impact ITW in childhood has on long term quality of life and social / functional outcomes and would be an important factor to consider in future research [25,26] Qualitative data highlighted ongoing debate and uncertainty regarding the natural history of toe-walking gait in a healthy population and how physical, and social impacts of the gait pattern changes over time [8]. Interpretation of current evidence on natural history appears to influence decision making and treatment planning for children who exhibit ITW in the UK. Although most health professionals determined treatment options in relation to clinical indicators, parent expectations were highly influential in determining the level and timing of intervention amongst health professionals in the UK. Other studies have highlighted the impact variation in treatment and diagnosis had on families and effective communication and support frameworks for families were recommended within future research [10]. Most surgeons in this survey would consider operating on children or young people diagnosed with ASD or ASD. Although there is debate as to whether children with ASD or ADHD associated toe-walking are classified as idiopathic (Soto Insuga et al, 2018), treatment intervention for ASD and ADHD associated toe-walking in the UK is considered to follow similar pathways. Children may also be diagnosed with ADHD or ASD at

a time after which they present with toe-walking (Reinker, 2018).. However, qualitative response suggested mixed outcomes for children with these conditions to both surgical and non-surgical interventions and there were calls for more research into this area. Effective screening for other related conditions and effective communication between health professions are also likely to positively impact patient satisfaction and long-term outcomes [16,27].

Despite numerous responses from paediatric physiotherapists and orthopaedic surgeons, this survey did not gain high response rates within relevant professional bodies or gather information from paediatric podiatrists, orthotists, plaster technicians, paediatricians, radiographers or clinical nurse specialists, all of whom were cited as being involved in some pathways of care for this condition. It is important to bear in mind that the key decision-maker for treatment and management of children with ITW in UK-based NHS treatment centres is often limited to physiotherapist and/or orthopaedic surgeons and this omission is, therefore, unlikely to have significant impact on outcomes. However, future studies considering professional consensus (e.g. Delphi study) would benefit from ensuring representation from all professions involved in potential pathways of care. Feedback from some participants suggested questions did not adequately clarify if participants should respond to questions if their service offered an intervention that the respondent was not directly involved in treatment delivery. This may be reflected in skipped questions or potentially limit knowledge of clinical indications and/or treatment choices in some cases.

Conclusion

This survey offers new information on current practices of children and young people who exhibit ITW. Physiotherapists are considered to play an important role in decision-making in care however, and the role of the orthopaedic surgeon in delivering effective long-term treatment for children with ITW remains vital. Current indications for treatment currently focus on physical impairment with a clear consensus that more research is necessary and that standardised pathways of care would be well-accepted by both health professional and families.

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