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Original Article

Spider Cage Therapy's Impact on GMFM-88 in Iraqi Infants with Cerebral Palsy in Two Rehabilitation Centers

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ABSTRACT

Background: This study aimed to evaluate the efficacy of incorporating spider cage therapy into the rehabilitation regimen of infants and children with cerebral palsy (CP) by assessing improvements in Gross Motor Function Measure (GMFM-88) scores. Rehabilitation of CP infants typically involves various therapies to improve motor function and overall development.

Methods: This interventional study involved 40 infants and children with CP who had undergone traditional rehabilitation prior to the implementation of spider cage therapy. The intervention consisted of structured sessions within the spider cage aimed at improving motor function. Data analysis was conducted using SPSS (Version 26.0). Continuous data were presented as mean ± SD, while categorical data were expressed as numbers and percentages. A paired t-test was used to compare the results before and after therapy, and an independent t-test and one-way ANOVA were employed to compare parameters, with significance set at $P \leq 0.05$. The calculated effect size (Cohen's d) is approximately 0.58, indicating a medium effect size. Additionally, a 95% confidence interval was used to detect a significant effect at a 5% significance level.

Results: The mean chronological age of the participants was 2 years (±1.6 SD), and the mean developmental age was 0.6 years (±0.2 SE) with a male-to-female ratio of 1.5:1. Most were hospital-delivered (92.5%), with 55% born via Caesarian section and 55% having NICU admission (median: 13 days ±5 SE). Medication usage varied, with 65% not taking any medication or only tonics, 25% on antispasticity drugs, and 10% on anti-epileptics. Additionally, 37.5% were premature, and 42.5% were low birth weight. Significant improvement in GMFM-88 scores was observed post-therapy (mean increase from 37.33 to 51.55, $p < 0.05$). GMFCS scores also improved (mean decrease from 3.73 to 3.00, $p < 0.05$). Improvements were more pronounced in those with a chronological age <3 years (not statistically significant) and a developmental age ≥1 year (statistically significant).

Conclusion: Spider cage therapy is a beneficial addition to traditional rehabilitation methods for managing cerebral palsy (CP). Early intervention, especially for younger infants, along with the use of accurate assessment tools such as GMFM-88, is vital for achieving the best possible results in this group.

Keywords: Chronological vs developmental age, CP, GMFM-88, Spider cage therapy, UEU

Introduction

Cerebral palsy is a group of permanent disorders of the development of movement and posture, causing activity limitation, that are attributed to nonprogressive disturbances that

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occurred in the developing fetal or infant brain (1, 2).

Epidemiology

Cerebral palsy (CP) is the most common motor disability in children, with a prevalence of 2-3 per 1000 births in the USA and Sweden. The highest prevalence of CP is found in cases related to low birth weight and/or prematurity. If a baby has a birth weight of less than 1,500 grams, the prevalence of CP increases to 59 per 1000 births. On the other hand, if the birth weight is greater than 2,500 grams, the prevalence decreases to 1.3 per 1000 births. In terms of prematurity, if a baby is born before 28 weeks, the prevalence rises to 111 per 1000 births, while if born after 36 weeks, the prevalence decreases to 1.3 per 1000 births (3, 4).

Clinical features and diagnosis

History: Prenatal, natal & post-natal events, Delays in their motor milestones such as rolling, sitting, crawling, standing and walking, and Abnormal motor patterns such as spasticity, dystonia, athetosis, or choreoathetosis, in addition to respiratory-feeding difficulties (1).

Examination: 1- Neurological examination including primitive reflexes.2- Gross Motor Function (GMF).

Imaging: MRI classification system for CP (MRICS) for cerebral palsy (CP)

Differential diagnosis: Idiopathic toe walking, Dopa-responsive dystonia, Hereditary spastic paraplegia, Friedreich's ataxia, Tethered cord, A leukodystrophy, and Metabolic disorders like inborn errors of metabolism (5, 6).

Classification

Topographical

1. Hemiplegia 40%, Diplegia 35%, Quadriplegia 23%.4.Triplegia & monoplegia & other forms less common 2% (7).

Types of movement disorder

1. Spastic (pyramidal) 75% - 85%.
2. Dyskinetic (extrapyramidal) 7% – 14%.
3. Ataxic or mixed 4% – 11% (8).

Functional level

GMFCS: Was developed as a means of classifying infant with CP based on their self-initiated gross motor movements in their typical environments (i.e., home, school, and community). Gross Motor Functional Measure-88 & Gross Motor Functional Measure-66 (Figure 1)(9).

Gross Motor Functional Measure: is a clinical measure designed and validated to evaluate changes in gross motor function in infant with CP & other neurological diagnoses (Figure 2).

It's not a GMFCS nor a screening tool.

It tests the five dimensions of child's development: A-E (11).

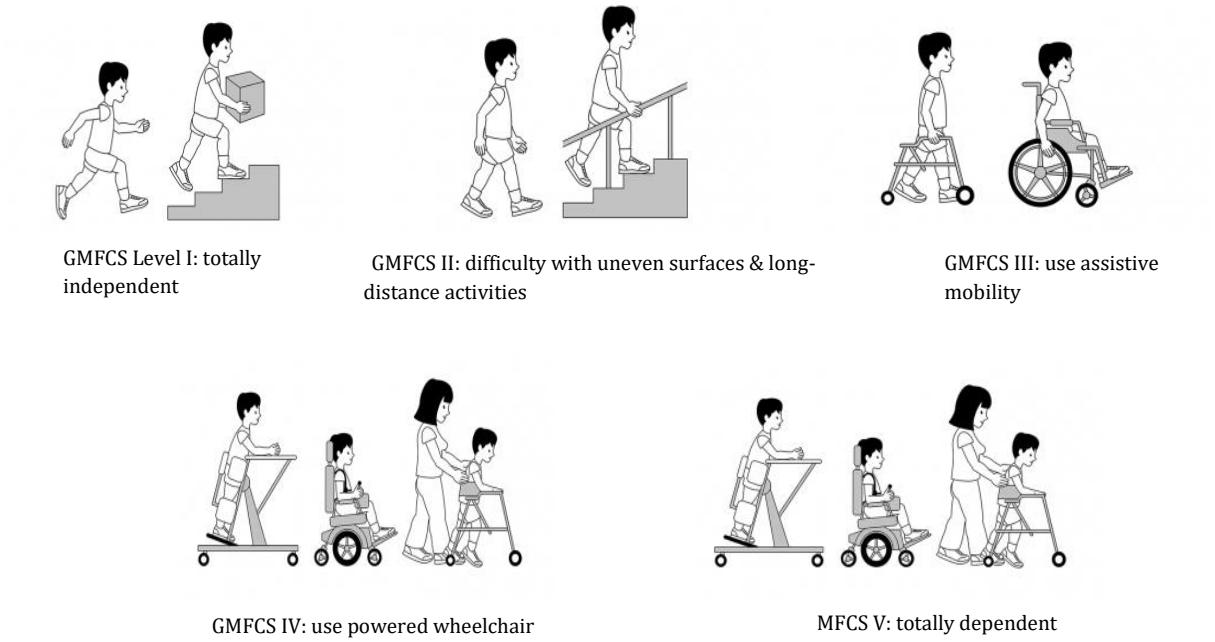

Figure 1. Gross Motor Functional Classification Score for cerebral palsy (10)

Figure 2. Equipment for applying Gross Motor Functional Measure GMFM

Equipment needed for applying Gross Motor Functional Measure GMFM

1. Mats minimum of 1.2m * 2.4m with thickness around 2cm.
2. Adjustable therapy bench minimizes or maximize accordingly.
3. five steps stairs rise 15-18cm.
4. Toys that can be touched with one or both hands &ball, & long stick 30-60cm for item 75.
5. Two taped parallel lines 20cm apart & 6m long with 2cm line width.
6. Circle 60cm diameter marked on the floor.
7. Space to run 4.5 meters.
8. Stool on castors (9).

Scoring GMFM

0 – Did not initiate or (Not tested in GMFM-88).
1 – Initiation (<10% of task).
2 – Partial completion (10 to <100% of task).
3 – Completion of task.
4 – Not tested added in GMFM-66 (accounted for in GMAE software) (9).

GMFM-88 & 66 item scoring guidelines

GMFM-88 & 66 tests the dimensions of the child's gross motor development with its subgrouping items in different positions with variable tasks:
A dimension:(lying & rolling) includes 17 items in supine & prone position.
B dimension:(sitting) includes 20 items in various aspects of sitting.
C dimension:(crawling & kneeling) includes 14 items in four points & high kneeling.
D dimension:(standing) includes 13 items in various aspects of standing.
E dimension:(walking, running & jumping) includes 24 items in variety of activities begin in standing (7).

Calculating Gross Motor Functional Measure-88 Dimension Scores

I- Manually calculate individual dimension scores by (Table 1):
– Adding all scores within a dimension.
– Divide by the number of tasks in that dimension.
– Multiply by 100.
– Record percentage.
II- Or enter individual dimension scores using GMFM App+, or GMAE-2 or 3 (9).

GMFM-88 SUMMARY SCORE

DIMENSION	CALCULATION OF DIMENSION % SCORES	GOAL AREA (indicated with ✓ check)
A. Lying & Rolling	Total Dimension A / 51 = ____ / 51 × 100 = ____ %	A. ☐
B. Sitting	Total Dimension B / 60 = ____ / 60 × 100 = ____ %	B. ☐
C. Crawling & Kneeling	Total Dimension C / 42 = ____ / 42 × 100 = ____ %	C. ☐
D. Standing	Total Dimension D / 39 = ____ / 39 × 100 = ____ %	D. ☐
E. Walking, Running & Jumping	Total Dimension E / 72 = ____ / 72 × 100 = ____ %	E. ☐
TOTAL SCORE =	(%A + %B + %C + %D + %E) / Total # of Dimensions	
=	____ / 5 = ____ = ____ %	
GOAL TOTAL SCORE =	Sum of %scores for each dimension identified as a goal area / # of Goal areas	
=	____ = ____ %	

Table 1. Gross Motor Functional Measure-88 score calculation (7)

Frequency of Gross Motor Functional Measure Administration

No specific guidelines about frequency of administration. Considerations include, but are not limited to the following (9):

– Age (consider more frequent evaluations for younger infant) .

– Type and intensity of intervention over a specified period of time.

– Estimated amount of time that the child will be required to learn a gross motor skill(s).

– Concurrent health status.

– Facility's administrative requirements for regular evaluation or lack of resources to provide regular evaluation (9).

Therapy

- Therapeutic hypothermia now the standard of care in treatment of neonatal encephalopathy (12).
- Therapies started when the child discovered to have developmental delays it needs a team work & initially through EI (From birth up to 3y.) (1).
- Therapist typically focusing on developmental skills by repetition (13):
- Gross motor skills: use large muscle of body as: lying, sitting, crawling, standing, walking…
- Partial body weight-supported treadmill training is a method that involves walking on a treadmill while receiving varying degrees of support. This allows children to concentrate on the quality of their movements and perform multiple repetitions (14).
- Fine motor skills: require higher precision as: feeding, dressing, bathing, grasping …
- Therapy after 3years if required, the family will develop Individualized Educational Program IEP with the school district which provides them with access to a developmental preschool class & ongoing therapy: PT, OT, ST & if needed vision therapy (1).

Exercises

Strengthening exercises
Stretching exercises
Aerobic Exercise
Constraint-Induced Movement Therapy (CIMT)

Orthosis

Lower extremity, upper extremity & trunk orthosis.

Equipment

variety of equipment that is used by infant with CP depending on their functional level and care needs.

Spider cage therapy

The Cage Therapy Unit, also known as the Universal Exercise Unit (UEU), is an exceptional and versatile device. It is a suspension system comprising pulleys, straps, bungee cords, and splints that are used for a wide range of exercises. This system effectively enhances strength, both passive and active range of motion, as well as muscle flexibility. The therapist can utilize this system to isolate and target specific muscle groups. It is worth noting that in this particular case, the movements are not affected by muscle tone, which usually tends to increase (15).

This enables muscle groups to counteract the spastic muscles, resulting in functional gains. As a result, the quality of gait, balance, and coordination of movements improves rapidly. This therapy allows patients with neuromuscular disorders to move more freely and independently compared to conventional therapy alone (Figure 3).

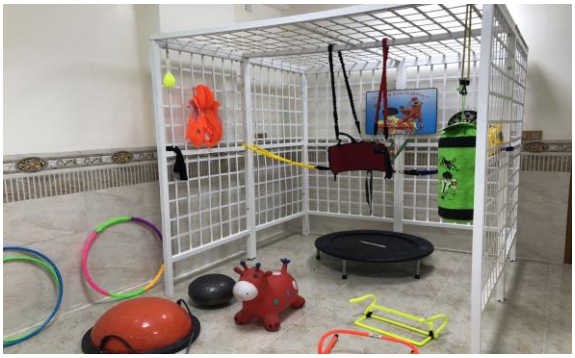

Figure 3. Spider cage a photo from Doctor Amenah private center for physical medicine and rehabilitation

Use of the spider cage (UEU) can aid in the development of functional skills such as(16):

1. Sitting.
2. Crawling.
3. Standing.
4. Walking.
5. Climbing.
6. Jumping.
7. Patient benefits include:
8. Increase range of motion.
9. Isolates desired muscle groups to strengthen them and enable function.
10. Eliminates gravitational forces acting on the body.
11. Improves balance.
12. Improves coordination.

13. Promote developmental milestones.
14. Facilitate upright position, improving breathe support and decreasing pressure.
15. Promotes independence and overall improved physical image (16).

Electrical stimulation

Neuromuscular electrical stimulation (NMES)

Robotic and Partial Body Weight Support Treadmill Training (PBWSTT)

Hypertonicity and Movement Disorder Management

Hypertonicity and movement disorders are best treated initially with conservative measures such as therapy, stretching, range of motion, and bracing. Reasons for treatment with medication include (17, 18):

1. Impairment of a child's function.
2. Pain.
3. Difficulty with cares such as diapering, dressing, bathing, or transfers.

Hypertonicity treatment is either general or focal:

A- Generalized hypertonicity treatment if not responding to conservative measures.

B- Focal management of spasticity or dystonia targeting specific muscles is with:

1. Chemodenervation
2. Chemoneurolysis

Musculoskeletal Surgical interference maybe needed in CP

Prognostic features

A- Structural outcome measures (directly related to body)

Because very few interventions for CP are expected to alter body structures, such as brain tissue, these types of outcome measures are seldom employed(19).

1. Imaging such as functional MRI.
2. Physiologic measures like transcranial magnetic stimulation.
3. Electromyography could be considered in this domain.

Functional outcome measures (related to spasticity/movement disorder)

1. Spasticity (Ashworth Scale, Modified Ashworth Scale & Tardieu Scale).
2. Specialized systems Strength (like muscle grading).
3. ROM.
4. GMFM-88 & 66, in addition to GMFCS.
5. Gait analysis (observational scales).

Best predictors of eventual ambulation

1. Persistence of primitive reflexes, or the absence of postural reactions at age 2 years is associated with a poor prognosis for ambulation.
2. Gross motor development, infant who were sitting by the age of 2 years eventually ambulated and that only 4% of the infant who were not sitting by 4 years ever gained the ability to ambulate.

Type of CP. Infant with spastic hemiparesis have the best prognosis for ambulation, with nearly (100%) achievement. More than (85%) of infant with spastic diparesis will eventually ambulate. The likelihood for ambulation is much less with spastic quadriparesis, but the studies have revealed a wide range of eventual ambulation of (0% to 72%)(Figure 4)(20).

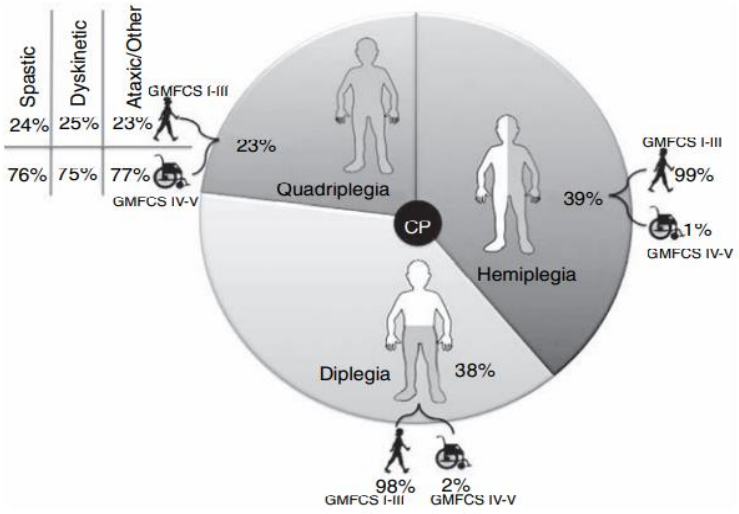

Figure 4. prognostic features (14).

Aims of the study

1. To find out the effect of adding spider cage therapy (Universal Exercise Unit) on GMFM promotion in infant with CP.

2. To assess the accurate and meaningful assessment & follow up of the CP child motor development by using the GMFM-88

Methods

Subject & Study Design

To the best of our knowledge, this study is the first of its kind conducted in Iraq. It is an interventional study that focused on Iraqi infants with cerebral palsy. The study was carried out at two rehabilitation centers, namely the Medical Rehabilitation Center (MRC) in Baghdad's Sader Al-Qanat and the Doctor Amenah Center for Physical Medicine and Rehabilitation in Karbala. The infants were followed up from December 2020 to November 2021.

Sample Selection

A purposive sample of a total of 40 patients (24 males and 16 females) was selected from an initial group of 68 children. The number of children decreased due to the COVID-19 pandemic, resulting in 40 children diagnosed with CP based on a referral from a neuropediatric subspecialist and brain MRI findings. The majority of these children had already undergone traditional rehabilitation sessions for over 3 months before being included in this interventional follow-up study. Parents were informed about the new intervention (21). The calculated effect size (Cohen's d) is approximately 0.58. This indicates a medium effect size, and a Confidence interval (95%), to detect a significant effect at a 5% significance level.

Forty infants and children with CP, who met strict inclusion criteria, underwent traditional rehabilitation prior to the implementation of spider cage therapy. Instead of using random allocation, we selected every case from the rehabilitation center through convenient sampling. This method ensured the inclusion of all eligible participants in the study (Figure 5). There was only one group (n=40) assessed before and after the intervention. The values before and after the intervention were reported in Table 3, which provides the significance of score changes before and after therapy using paired samples statistics.

Diagnostic criteria for CP (presence of one or more of the followings) (22)

1. Delay mile-stone with absence of other explanation for that delay.

2. Persistence of some of the primitive reflexes &or brisk some deep tendon reflexes & positive superficial reflexes.

3. Presence of movement disorder like spasticity or dyskinesia or choreoathetosis.

5. Non progressive neurological insult in a child not having features of metabolic or chromosomal anomalies.

5. Neuroimaging specially MRI in suspicious cases.

Inclusion Criteria

1. Both gender with CP infant aged 8m to 8 years

2. Gross Motor Function Classification System level I-V.

Exclusion Criteria

1. Subluxation or dislocation of hip.

2. Scoliosis exceeding 25 degrees.

3. Known complicated systemic disorders like high blood pressure.

4. Uncontrollable seizures.

5. Usage of Botulinum toxin A injection within 3 months prior to study.

Data Collection

A questionnaire was administered to collect information from the patients, and verbal consent was obtained from each participant for inclusion in the study. The questionnaire, which included English and Arabic translations, was referenced in Appendix 1. Each child was evaluated on 88 tasks, with a grading system ranging from zero (unable to complete the task) to three (able to fully complete the task). The scores from all 88 tasks were then calculated as a percentage using a specific equation, both before and after therapy. The therapy itself involved various activities, including exercises to improve balance, proprioception, and mobility. These exercises were conducted using equipment such as bungee cords, a trampoline, a half ball, a bean-like ball, a Swiss ball, and a balancing board. For infants under one year old, a total of four, a couch was introduced into the spider cage to facilitate control of their sitting activities.

Statistical Analysis

The data were statistically analyzed using the Statistical Package for the Social Sciences (SPSS) version 26.0. For continuous data, the mean ±

standard deviation (SD) was calculated, while categorical data was presented as numbers and percentages. To compare the results before and after therapy, a paired t-test was conducted. Additionally, an independent t-test and one-way ANOVA were used to compare parameters and determine significance, with statistical significance considered at a p-value ≤ 0.05.

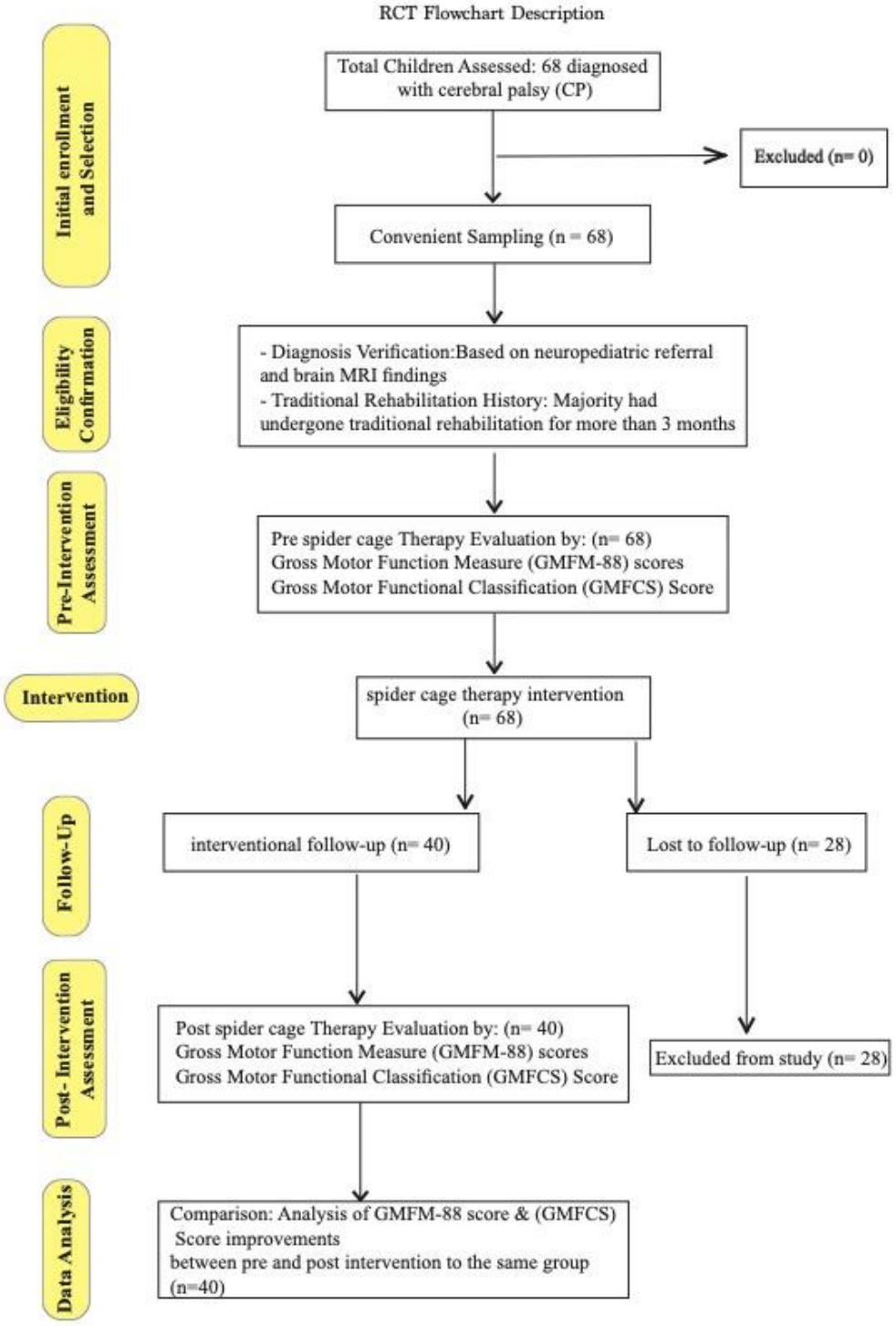

Figure 5. The flowchart of randomized controlled trial

Ethical Approval

This study obtained ethical approval from the Iraqi Board of Medical Specialties under reference number 609, dated 10-2-2021. Informed consent was obtained from the legal guardians or parents of all participating infant. The study strictly adhered to ethical standards and guidelines for research involving human subjects.

Results

The mean chronological age of the infant was 2y±1.6ySD, and the mean developmental age of the infant was 0.6y±0.2ySE with male to female ratio 1.5:1, 92.5% of them were hospital delivered, 55% of them were C.S. delivered, 55% of them have history of NICU admission with a median period of 13d±5SE, 65% of them were not taken medications or only tonics, while (25%) were on antispasticity & the other 10% were on anti-epileptics. (37.5%) & (42.5%) were immature & low birth weight respectively. They were on variable type of feeding, there median weight & height was slightly lower than 50th centile., their median head circumference slightly lower than 50th centile, only (35%) of them were using aids, the level of their parents' education was variable & the consanguinity was (32.5%), the positive family history of CP was (10%), 95% of the cases were spastic type of CP while the remaining 5% were non spastic (Figure 6, Table 2). There was a significant improvement in the infant GMFM-88 & even GMFCS two months after therapy (p value <0.05) (Table 3). Also, improvement noticed to be higher at a chronological age <3y but statistically not significant, also developmental age higher or equal to 1y shows more significant improvement (Table 4).

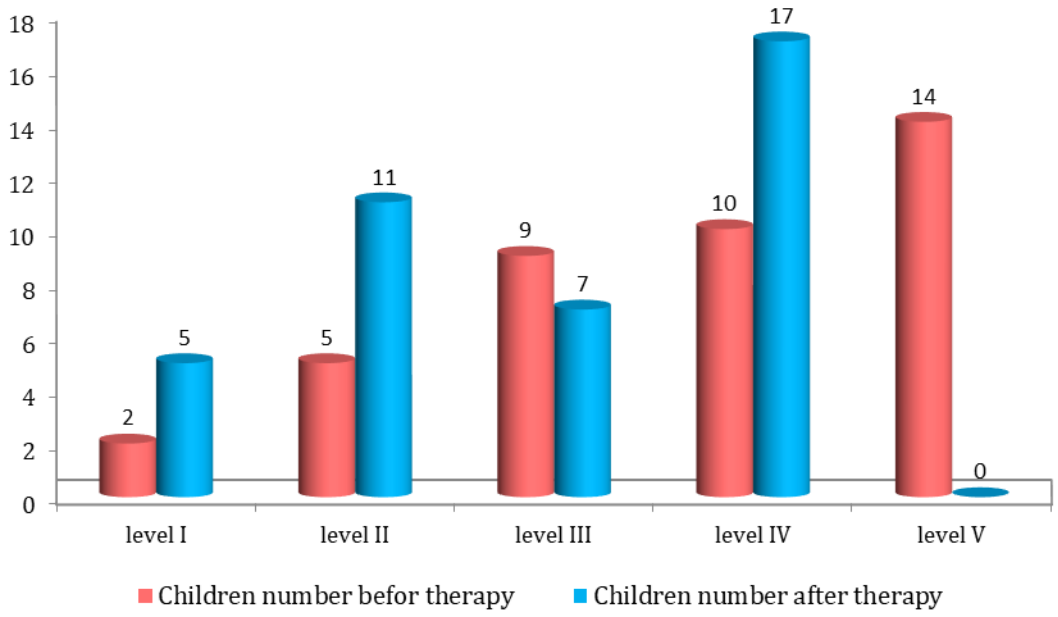

Figure 6. Frequencies of CP severity GMFCS before and after Therapy

Table 2. Demographic data & health related characteristics of the studied groups

Variables	Categories	No. (%) &or Mean±SD
Gender	Male	24 (60%)
	Female	16 (26%)
Age	Chronological age	2y (±1.6y) SD
	Developmental age	0.6y (±0.2y) SE
Delivery place	Hospital	37 (92.5%)
	Home	3 (7.5%)
Delivery type	NVD	18 (45%)
	CS.	22 (55%)

Table 2. Continued.

NICU admission	Not admitted Admitted	18 (45%) 22 (55%) Mean duration 13d±5SE
Medications	Non or only tonics Baclofen (anti-spasticity) Anti-epileptics & others	26 (65%) 10 (25%) 4 (10%)
Feeding type	Breast Bottle Mixed	12 (30%) 19 (47.5%) 9 (22.5%)
Birth maturity	Mature (term) Immature (preterm)	25 (62.5%) 15 (37.5%)
Birth weight	Low <2500g Normal >=2500g	17 (42.5%) 23 (57.5%)
Recent weight (divided upon median)	<=11 kg >11 kg	23 (57.5%) 17 (42.5%)
Height (divided upon median)	<=80 cm >80 cm	22 (55%) 18 (45%)
Head circumference (divided upon median)	<47 cm >=47 cm	18 (45%) 22 (55%)
Aids using	Not using Using especially AFOs	26 (65%) 14 (35%)
Parents education	Primary or illiterate Secondary University or higher	12 (30%) 15 (37.5%) 13 (32.5%)
Parents consanguinity	Non relative Relative	27 (67.5%) 13 (32.5%)
Family history of CP	Negative Positive	36 (90%) 4 (10%)
CP type	Spastic hemiplegic Spastic diplegic Spastic quadriplegic Non spastic	10 (25%) 13 (27.5) 15 (37.5%) 2 (5%)
Place of therapy	Private CP center Governmental CP center	19 (47.5%) 21 (52.5%)

Table 3. The significance of score changes before and after therapy a paired samples statistic

	Mean	N	Std. Deviation	P-value
GMFCS before 2 months spider cage therapy (I-V)	3.7250	40	1.19802	0.0001
GMFCS after 2 months spider cage therapy (I-V)	3.0000	40	1.06217	
GMFM-88 before 2 months spider cage therapy (0-100%)	37.3250	40	25.34621	0.0001
GMFM-88 after 2 months spider cage therapy (0-100%)	51.5500	40	23.67185	

Table 4. The results of the comparative relation between the GMFM-88 score & the studied variables.

Variables	Categories	GMFM-88 (mean±SD)	P value
Gender	Male	15.63±10.63	0.282
	Female	12.13±9.77	0.280
Chronological age	<=3y	15.9±10.4	0.091
	>3y	9.9±7.3	0.053
Developmental age	<=6mth	18.4±11.9	0.06
	7-11mth	13.3±8.2	
	>=1y	9.8±6.6	0.02

Table 4. Continued.

Delivery place	Hospital	14.6±10	0.452
	Home	10±7.2	0.391
Delivery type	NVD	15±11.9	0.639
	CS.	13.5±8.1	0.652
NICU admission	Not admitted	13.5±13	0.535
	Admitted	16.6±10	0.573
Medications	Non or only tonics	16±10.9	0.190
	Lioresal (anti-spasticity)	12.6±6.7	
	Anti-epileptics & others	6.7±6.4	
Feeding type	Breast	16±11.8	0.603
	Bottle	14±9.9	
	Mixed	11.6±7.6	
Birth maturity	Mature (term)	13.7±10.7	0.684
	Immature (preterm)	15±8.8	0.669
Birth weight	Low <2500g	13±9.5	0.552
	Normal >=2500g	15±10.4	0.547
Recent weight (divided upon median)	<=11 kg	16±10.5	0.134
	>11 kg	11±8.6	0.124
Height (divided upon median)	<=80 cm	16±10.6	0.127
	>80 cm	11±8.5	0.119
Head circumference (divided upon median)	<47 cm	16±11.9	0.218
	>=47 cm	12±7.9	0.239
Aids using	Not using	16±11	0.135
	Using especially AFOs	11±7	0.091
Parents education	Primary or illiterate	9.5±6.9	0.145
	Secondary	16.4±11.6	
	University or higher	16±9.4	
Parents consanguinity	Non relative	11.6±10	0.255
	Relative	15±10	0.269
Family history of CP	Negative	15.7±14.7	0.751
	Positive	14±9.6	0.636
CP type	Spastic hemiplegic	14±7	0.537
	Spastic diplegic	13.7±12	
	Spastic quadriplegic	13±10	
	Non spastic	24±6	

Discussion

The study examined the effectiveness of adding new interventions, specifically Spider Cage therapy and the Gross Motor Functional Measure-88 (GMFM-88), in managing and assessing patients with cerebral palsy (CP). The GMFM-88 is a tool developed by the Canadian Can Child research center of McMaster University and is considered the most accurate and meaningful tool for assessing and monitoring the motor function of infants with CP. The results of the study showed a significant improvement in both the GMFM-88 scores and the Gross Motor Function Classification System (GMFCS) level in patients who received Spider Cage therapy in addition to traditional physiotherapy. This difference was statistically significant with a p-value of <0.05. This finding is consistent with a previous Indian study conducted in 2016, which also demonstrated a significant improvement in motor function using Spider Cage therapy compared to traditional physical therapy when using the GMFM (22). It is noticed that the percentage of male gender (60%) with CP were higher than female percentage (40%) which is consistent with the results of study done in UK at 2005 showed that the larger is the proportion of male cases (23).

Most of the infant with CP in this study were

presented at a chronological age of 2 years (±1.6y)SD and a developmental age of 6 months , those results were consistent with the results mentioned in Delisa's textbook, & there was a noticeable improvement in the GMFM-88 score for those infant <3 years in comparison to those >3 years but statistically not significant the p-value >0.05 & there was a significant improvement in the GMFM-88 for those with higher developmental age >1year p-value <0.05 , its mentioned in Delisa's textbook that the earlier age rehabilitation starts & the higher developmental performance the better the results (1).

Majority of the infant with cp in this study were hospital born (92.5%) & (55%) of them were C.S delivered; a study done by Keag O et al. mentioned that babies born by C.S. may be more likely to have breathing problems at birth (24).

In this study (55%) of CP infant were admitted to NICU, while in other study done in India on 2020 there were (65.3%) (n=51) cases had a history of NICU admission (25). The percentage of CP patients in this study with epilepsy & were on anti-epileptic medications was (10%), while it's mentioned in Delisa's textbook to be around (17%) (1). Majority of the CP infant in this study were spastic in type (95%), its mentioned in the Australian family Physician Journal that spastic CP is the most common motor type with a prevalence of 70% (26).

Only (25%) of CP infant with spasticity were on anti-spasticity medications like Lioresal (Baclofen) studies demonstrate that oral baclofen has an effect beyond placebo in improving goal-oriented tasks, such as transfers, in infant with spastic CP (27). There was no significant difference in the outcome of GMFM-88 improvement between various types of spastic CP, while it's mentioned in Delisa's textbook that those with hemiplegic & diplegic type of CP have a better outcome while the poorest outcome is with quadriplegic CP {Scheinberg, 2006 #27369;Bergerat, 2021 #27373}.

Only 30% of the infants with CP in the study were breastfed, while 47.5% were bottle-fed, and 22.5% had a mixed type of feeding. This variation may be attributed to different levels of feeding difficulties that they are experiencing (Diwan, 2015 #27374) (28). Among the CP infants included in the study, 37.5% were born prematurely, while the majority (62.5%) were full-term. These results are consistent with other studies that indicate that the most common cause of CP is unknown in 50% of cases, with prematurity being the most common risk factor. It is important to note that there are typically more full-term infants born at any given time compared to preterm infants (29). The percentage of those with low birth weights <2500g were (42.5%) which's in combination with prematurity known to be of the most important risk factors for CP (9), while the percentage of those with a birth weight of equal or >2500g was (57.5%).

The median weight 11kg & height 80cm of the CP infant were lower than that of normal infant 12kg & 86cm (30) which may be attributed to various causes including that must be studied in the future like: feeding difficulties, social communication problems, recurrent illnesses & sometimes neglect.

The median of the head circumference for cp infant was 47 cm which's slightly lower than that for normal infant (31). The percentage of CP infant using supportive aids for ambulation in this study was (35%), while in other study they found that (26.98%) were able to walk with support (32). History of consanguinity in this study was 23.5% while in another study was (35.9%) which's considered one of the risk factors for congenital CP (25).

The level of the parent's education in this study was variable & divided to approximately three thirds: the 1st third were the illiterate & primary school education & the 2nd third were the secondary school education & the 3rd third were the university plus higher education, while in a study done in Bangladesh (2.5%) of the respondents were illiterate or without education, (10.7%) had primary education, (68.5%) secondary level, higher secondary (10.7%) and (7.5%) had graduate educational qualification (33).

There was no significant relation between the parent's education & the improvement of their infant GMFM, while the higher level of education had a positive effect in other study (33). In this study, the family history of CP was found to be positive in 10% of the participants. Furthermore, half of these individuals had a history of twins, which is considered as one of the risk factors for CP. Another study revealed a consistent result of 6% having a history of twin pregnancy (33).

Limitations

1. The research data collection & intervention done during the era of COVID-19
2. The noncompliance of some of the parents decreases the likelihood of having full chance of highest level of improvement.
3. Non-availability of some of the equipment

which overcame by donating them to the rehabilitation center.

4. Memory biases due to the design of the study in which some of them due to long time they gave information as they can remember.

Conclusion

Spider cage therapy, along with assessment and follow-up using the GMFM-88 score, has proven to have a significant impact on improving infants with cerebral palsy (CP) compared to traditional rehabilitation methods. The sooner rehabilitation starts for infants with CP, the better their response and more noticeable improvements, especially when accurately measured by the GMFM-88 score. Additionally, older infants with CP show better functional improvement with spider cage therapy, especially when accurately measured by the GMFM-88 score.

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Conflicts of interest

The authors have no conflicts of interest to report.

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