Clinical feasibility of Inclusive Telephysiotherapy (i-TelePT) in therapeutic monitoring of the Physical Impairments in Children with Cerebral Palsy in an Inclusive Education Setting

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Abstract

Introduction Tele-physiotherapy has been shown to be beneficial in improving physical limitations in children with cerebral palsy. However, inclusive telephysiotherapy (i-TelePT) based monitoring and interventions for children with CP in school settings are scarce. This study aimed to assess the feasibility of a novel framework of i-TelePT for children with cerebral palsy in school settings in the Mandidistrict of Himachal Pradesh, India.

Methods A quasi-experimental study was conducted to assess the clinical feasibility of i-TelePT for children with CP (n=20) aged between 6-12 years in an inclusive education setting. The i-TelePT programme was delivered for one hour per session, for a total of 8 weeks, with the support of special educators. 10141

Results The mean age of the participants in this study was 9.8±1.69.There was significant improvement in balance score (‘t’= -3.976, SEM = 0.893, ‘p’ < 0.001). Similarly, in the pain intensity, a statisti- cally significant improvement as compared with the baseline (p<0.001).Pre and post intervention score of motor functions demonstrated with a mean difference score -9.7±7.6 (p<0.001). MACS score (z value = -3.3 and p value ≤ 0.001 and GMFCS score (z value= -2.236 and p value ≤ 0.025) was also found statistical significant respectively. There was improvement in spasticity measured on MAS in all lower limb muscles with a statistical significant score (p value ≤ 0.001) except external and in- ternal rotators of hip as well as knee flexors on left side (p value > 0.05). There was no improvement in of upper limbs of both sides (p value > 0.05). Significant improvement in WeeFIM function independence in all domains (p value ≤ 0.001) however, there was no improvement in communicationlevel of WeeFIM among all CP children (p value > 0.05). There was also significant improvement ('p' ≤ 0.001) in all seven domains of quality of life (CPQoL).

Conclusion The study highlights the potential benefits of incorporating telephysiotherapy into special education programs. These findings will encourage further exploration and implementation of this innovative approach for children with disability.

Keywords Inclusive Telephysiotherapy,Cerebral palsy, Disability, Therapeutic, Education setting, Special educator.

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INTRODUCTION

Cerebral palsy (CP) is the most common cause of physical impairments with abnormalities in both gross and fine motor abilities. At the age of entering school, the motor incompetency in such unusual youngsters typically becomes more obvious[1,2].Lack of motor skills in schools hinders a child's academic and extracurricular activities[3,4].Due to inadequate medical treatment and financial resources, particularly in unfavourable geographic situations like hills, CP children, especially those living or studying in remote places, face barriers to accessing rehabilitation programmes[5,6].

The Indian government has implemented several programs to provide rehabilitative services in addition to schooling. Unfortunately, some children with cerebral palsy who are confined to their beds at home are unable to receive school-based treatments. Additionally, therapeutic camps operated by school administrations are unable to meet the unique therapeutic needs of CP children[7,8]. Every kid with CP has the right to receive an education alongside typically with other normal children and should receive relevant treatment interventions to promote inclusivity.To achieve desired educational goals, the management of physical impairments should be given top priority. The inclusive management at school can improve these children's quality of life[9,10].

In order to address physical impairments and disabilities in children with cerebral palsy (CCP), it is crucial to implement innovative and cost-effective therapies that utilize information and communication technology (ICT). These therapies can promote curriculum activities and enhance functional capacity in educational settings. Fortunately, numerous organizations have been empowered by rapidly advancing medical and paramedic technology to provide children with impairments with higher quality rehabilitation treatments[11,12].

The World Health Organization has identified numerous potential benefits of telephysiotherapy, which could revolutionize the approach to rehabilitation treatment during this time. This innovative method of delivering physiotherapy services remotely has the potential to improve patient outcomes, increase accessibility to care, and reduce healthcare costs[13,14]. There have been several literature studies in the past addressing telephysiotherapy (TelePT) for various ailments or impairments in India and throughout the world[15–19].TelePT have been demonstrated to be viable and successful in paediatric occupational therapy trials including children with cerebral palsy[20]. It has also been demonstrated to be a viable treatment for musculoskeletal problems and has been utilised as a substitute to in person treatment for developmental disorders[21–23].

Despite the potential benefits of TelePT for disabled children in both urban and rural areas, there has been a lack of research on its viability in inclusive educational settings. While some researchers have advocated for the use of TelePT for children with cerebral palsy in school settings, it has not been widely adopted. In fact, there has never been a study on inclusive TelePT (i-TelePT) conducted anywhere in the world, making this work a pioneer in both academic and clinical terms. This gap in the literature has sparked a strong interest among clinical care providers in the potential of expanding the use of information and communication technology (ICT) to address physical disabilities. To address this need, the aim of this study was to assess the clinical feasibility of i-TelePT in the treatment and monitoring of patients.

MATERIAL & METHODS

Study Design & Participants
In a quasi experimental non-randomized single group pre & post intervention study, a total of (n=20) medically certified CCPs of 6-12 years age fulfilling the inclusion criterion were elected from educational blocks in hilly terrains of District Mandi, Himachal Pradesh (H.P), India. Correspondingly, all special educators with at least 2 years professional experience in serving such children in school settings were also screened out from same educational blocks of the district. The informed consents were received from the parents of the children as well as special educators prior to participate in study.

Ethical considerations
The study was condoned by Institutional ethical committee, Lovely Professional University, Punjab (LPU/IEC/2019/01/09). The potential risks and benefits to all entrants together with their custodians were explained before inclusion in the study.

Inclusion & Exclusion Criterion
Inclusion criteria of the study were 1. C.P students of all types (6- 12 years) certified with 40% disabilities on medical certificates; 2. CCPs with mild Intellectual disability; 3. CP students classified with all grades of GMFCS[24]; 4.CP pupils from all sections of elementary and middle classes; 5. Candidates and their guardians granting their permission to take part in the current study. Exclusion criterions presented in study:1. CP chap of matric and intermediate classes; 2. Children with Developmental delay, Down syndrome, autism & epilepsy or undergone surgery or having Botox injections within 6 months before therapy; 3. CCP with hearing /visual impairments, moderate and severe/profound Intellectual disability.

Outcome measures
The various standardized tools of assessment are the Gross Motor Function Measure (GMFM-88)[25,26];Gross Motor Function Classification System (GMFCS, E&R)[24];The Cerebral Palsy Quality of Life Questionnaire (CPQOL)[27]; Goal Attainment Scaling (GAS)[28];Wee Functional Independent Measure (WeeFIM)[29];Modified Ashworth Scale (MAS)[30]; Manual Ability Classification System (MACS)[31,32]; Paediatric Balance Scale (PBS)[33].

Procedure
A survey was carried by the researcher by obtaining preliminary data from the State Government institute situated in Mandi District (HP) regarding CCPs. Children with CP were screened based on inclusion criterion and all children were evaluated individually along with educators engaged with these children in respective educational blocks.
Furthermore, the basic demographic information was asked from all the special educators by sending the Google form to them. The individualized telephysiotherapy groups (TP-1 to TP-10) were constituted for special educators, parents of CP children of different educational blocks to disseminate information about Telephysiotherapy and its delivery. Prior to start the telephysiotherapy, all special educators were trained in implementation of telephysiotherapy including both synchronous as well as asynchronous delivery under supervision of therapist. In preliminary stage, zoom testing was done on one child to see response of telephysiotherapy in remote hilly area.
The School Central Cluster Lab (SCCL) and Home Android Lab (HAL) were utilized by special educators by visiting homes of CCPs oftheir respective educational block. To standardize and assurance of the visit at home, a lists of planned therapeutic activities were given to educators and parents who interacted with therapist via video conferencing (VC) through HAL. Therapy session recording form were filled and kept for each and every child after every i-TelePT session. The ethical aspects including privacy, confidentiality of patients for both patients as were as of therapist were followed. The i-TelePT intervention was composed of one hour duration long sessions delivered over a period for 8 weeks.

On the contrary, therapist also designed the web page containing videos and pictures of exercise protocols designed individually for children apart from interactive sessions for rest of days of week to prevent any gap in therapy sessions. The offline asynchronous interaction of CCPs permits the browsing of exercise rehabilitation sessions. The id and password were sent to all educators and parents of CP children for asynchronous i-TelePT services.

Statistical analysis

Using SPSS version 28.0(IBM), descriptive statistics were utilised to summarise participants responses and demographic data.

RESULTS

This Feasibility of i-TelePT was measured through adherence, safety, technical feasibility and clinical Efficacy. Table 1 displays the socio-demographic characteristics of study subject with an average age was 9.8 (±1.69) years.

Table 1. Demographic and attendance (Online & Offline) of the participants

Characteristics	Mean ±SD
Mean Age (Years)	(9.8±1.69)
Gender (Male/Female)	11(55%)/ 9(45%)
Attendance (i- TelePT Online)	(68.1±32.81)
Attendance (i- TelePT Offline)	(39.6±5.13)

Table 2 displays the balance, pain intensity and gross motor function of all (n=20) CP children. There was significant improvement in balance score as the difference in pre and post intervention mean difference PBS score (-3.55) was statistically significant ('t'= -3.976, SEM = 0.893, 'p' < 0.001). Similarly, the pain intensity, a statistically significant improvement (p<0.001) as compared with the base- line score.

Table 2. PBS, VAS, GMFM-88 Pre & Post i-TelePT results after 8 weeks (Paired –T test)

Tools	Baseline		Week 8 post intervention					
	Mean	SD	Mean	SD	Mean Diff.	SEM	t Value	p Value
PBS	21.4	17.1	24.9	19.5	-3.55	0.89	-3.9	0.001*
VAS	6.50	0.82	3.40	1.40	3.10	0.35	8.7	0.001*
GMFM-88	56.4	22.9	66.1	23.9	-9.73	1.70	-5.6	0.001*

*Significant results at p<0.05. GMFM-88= Gross Motor Function Measure-88, PBS=Paediatric BalanceScale, VAS=Visual Analogous scale, SD=Standard deviation, SEM= Standard error of mean, CI= Confidence Interval

Table 3 displays individualize goal attainment and fine-motors skills. The pre interventions mean GAS pre T score was (35.99 ± 0.40) and the post intervention mean GAS T score was (56.26 ± 9.28). The difference in pre and post intervention mean was statistically significant ('z' = 3.920, 'p' < 0.001).

Table 3. GAS, MACS and GMFCS-E & R Pre & Post i-TelePT intervention results

Tools	Negative rank Pre			Positive rank Post				
	Mean (SD)	Mean Rank	Sum of rank	Mean (SD)	Mean Rank	Sum of rank	Z Value	P Value
GAS	35.9(0.4)	0.0	0.0	56.2(9.2)	10.5	210.0	-3.9	0.001*
MACS	2.55(1.1)	6.0	66.0	2.00(1.0)	0.0	0.0	-3.3	0.001*
GMFCS-E&R	2.85(1.4)	3.0	15.0	2.6(1.4)	0.0	0.0	-2.2	0.025*

*Significant results at p<0.05. GAS=Goal Attainment Scaling, MACS=Manual Ability Classification System, GMFCS-E&R= Gross Motor Functional Classification System-Expanded and Revised.

The pre-intervention mean MACS score was 2.55±1.1 and post intervention mean MACS score was 2.0±1.0 with a statistical significant (z value = -3.3 and p value ≤ 0.001. The pre intervention mean GMFCS score was 2.85±1.4 and post intervention mean GMFCS score was 2.6±1.4 (z value= -2.236 and p value ≤ 0.025). Table 4 displays the muscle spasticity among the study subjects of different muscles. Comparatively, there was improvement in all lower limb muscles TA, Hip flexors, Hip extensors, Hip abductors, Knee extensor muscles with a statistical significant score (p value ≤ 0.001) except external and internal rotators of hip as well as knee flexors on left side (p value > 0.05). There was no improvement in of upper limbs of both sides (p value > 0.05).

Table 4. MAS Pre & Post intervention after 8 weeks follow up (Wilcoxon Signed Rank test)

Tools	**Right**								**Left**							
MAS	Pre			Post					Pre			Post				
	Mean	Median	Mode	Mean	Median	Mode	Z	P	Mean	Median	Mode	Mean	Median	Mode	Z	P
TA	2.10	2.0	1	1.55	1	1	-3.05	0.002*	2.10	2.50	3	1.45	1.00	1	-2.75	0.006*
HIPFL	1.30	1.0	1	0.80	0	0	-2.64	0.008*	1.45	1.00	1	0.85	0.00	0	-2.97	0.003*
HIPEXT	0.95	0.5	0	0.35	0	0	-2.41	0.016*	0.95	0.50	0	0.35	0.00	0	-2.22	0.026*
HIPAD	1.40	1.0	0	0.95	1	1	-2.71	0.007*	1.50	1.00	0	0.95	1.00	1	-2.59	0.009
HIPAB	1.35	1.0	1	0.15	0	0	-3.44	0.001*	1.15	1.00	1	0.05	0.00	0	-3.30	0.001*
HIPIR	0.85	0.0	0	0.60	0	0	-2.23	0.025*	0.85	0.50	0	0.60	0.00	0	-1.89	0.059
HIP ER	0.65	0.0	0	0.35	0	0	-1.40	0.161	0.55	0.00	0	0.40	0.00	0	-0.59	0.550
KNEEFL	2.00	2.5	3	1.30	1	0	-2.91	0.004*	1.90	1.50	1	1.45	1.00	1	-2.49	0.014
KNEEX	1.40	1.0	0	0.40	0	0	-3.00	0.003*	1.25	1.00	0	0.20	0.00	0	-2.90	0.004*
SHFLEX	0.05	0.0	0	0.05	0	0	-1.0	0.317	0.20	0.00	0	0.15	0.00	0	0.00	1.000
SHEXT	0.10	0.0	0	0.05	0	0	-1.00	0.317	0.10	0.00	0	0.05	0.00	0	-1.00	0.317
ELBFL	0.30	0.0	0	0.25	0	0	-1.00	0.317	0.25	0.00	0	0.20	0.00	0	-1.00	0.317
ELBEX	0.20	0.0	0	0.10	0	0	-1.41	0.157	0.20	0.00	0	0.10	0.00	0	-1.41	0.157
WRFL	0.30	0.0	0	0.30	0	0	0.00	1.00	0.35	0.00	0	0.30	0.00	0	-1.00	0.317
WREXT	0.05	0.0	0	0.00	0	0	-1.00	0.317	0.05	0.00	0	0.00	0.00	0	-1.00	0.317
PRON	0.10	0.0	0	0.05	0	0	-1.00	0.317	0.05	0.00	0	0.30	0.00	0	-1.63	0.102
SUP	0.05	0.0	0	0.05	0	0	0.0	1.00	0.10	0.00	0	0.00	0.00	0	-1.41	0.157
FINGFL	0.10	0.0	0	0.10	0	0	0.0	1.00	0.10	0.00	0	0.10	0.00	0	0.0	1.00

MAS=Modified Ashworth Scale; TA=Tendoachillies; FL=Flexors; EXT=Extensors; ADD =Adductors; ABD=Abductors; IR=Internal Rotators; ER=External Rotators; SH=Shoulders; ELB=Elbow; WR=Wrist; PRON=Pronators; SUP=Supinators; FING=Finger

Table 5 shows significant improvement in function independence in self-care, sphincter control, transfer, locomotion and social cognition (p value ≤ 0.001) however, there was no improvement in communication level of WeeFIM among all CP children (p value > 0.05).

Table 5 .WeeFunctional Independence Measure (WeeFIM) pre & post intervention after 8 weeks follow up (Wilcoxon Signed Rank Test)

Tools	**Negative rank**			**Pre**	**Positive rank**			**Post**	**Z Value**	**P Value**
WeeFIM Sub domains	Mean (SD)	Mean Rank	Sum of Rank	WeeFIM Levels (1-7)	Mean (SD)	Mean rank	Sum of rank	WeeFIM Levels (1-7)		
Self care	20.5(9.2)	6.0	6.0	3	22.2(9.1)	6.5	72.0	3	-2.604	0.009*
Sphincter control	10.4(6.8)	0.0	0.0	2	11.3(6.6)	4.5	36.0	3	-2.555	0.011*
Transfer	11.4(6.9)	2.5	5.0	3	12.4(6.7)	6.2	50.0	3	-2.316	0.021*
Locomotion	7.3(4.30)	5.5	5.5	3	8.4(4.4)	8.1	114.5	3	-3.207	0.001*
Communication	10.7(2.7)	0.0	0.0	4	10.9(2.7)	2.0	6.0	4	-1.633	0.102
Social cognition	15.2(4.3)	0.0	0.0	3	15.6(4.4)	3.5	21.0	3	-2.271	0.023*

*Significant results at p<0.05;4(75% or more): Minimal resistance; 3(50% or More): Moderate assistance; 2 (25% or more): Maximal assistance

Table 6. CPQoL Domains Pre & Post intervention after 8 weeks follow up (Paired T-Test)

Tools	Domains	Pre		Post		Mean Diff.	95% CI (L)	95% CI (U)	t value	P value
		Mean	SD	Mean	SD					
CPQOL	Social Wellbeing &Acceptance	55.2	19.7	59.7	18.2	-4.5	-6.5	-2.5	-4.7	0.001*
	Feeling about functioning	52.9	19.1	58.1	18.8	-5.1	-7.0	-3.2	-5.6	0.001*
	Participation & physical health	48.8	19.8	53.5	19.8	-4.6	-6.8	-2.4	-4.4	0.001*
	Emotional well being & Self esteem	52.9	17.6	57.2	17.7	-4.2	-6.1	-2.4	-4.7	0.001*
	Access to services	50.6	16.9	56.2	17.3	-5.6	-8.1	-3.1	-4.6	0.001*
	Impact of disability	46.3	15.4	46.2	13.4	-2.8	-5.1	-0.5	-2.5	0.018*
	Family health	61.7	13.6	65.1	12.8	-3.4	-5.5	-1.3	-3.3	0.003*

*Significant results at p<0.05. CPQoL= Cerebral Palsy Quality of Life, (L) =Lower, (U) = Upper

Table 6 shows the quality of life in study subjects. There was significant improvement in seven domains (Social well-being- 't'=-4.7, SEM = 0.95, 'p' ≤ 0.001, Feeling about function 't'=-5.6, SEM=0.91, 'p' ≤ 0.001), regarding the difference in pre and post intervention mean difference CPQoL (Participation & physical health) score (-4.63) was statistically significant ('t'=-4.4, SEM=1.04, 'p' ≤ 0.001), similarly, talking of, the difference in pre and post in- tervention mean difference CPQoL (Emotional well being & Self esteem) score (-4.29) was statistically significant ('t'=-4.7, SEM= 0.90, p≤ 0.001), as for the difference in pre and post intervention mean difference CPQoL (Access to services) score (-5.63) was statistically sig- nificant ('t= -4.6, SEM = 1.20, 'p' ≤0.001), in the same way, difference in pre and post in- tervention mean difference CPQoL (Impact of disability) score (-2.84) was statistically significant ('t'= -2.5, SEM = 1.10, 'p' ≤ 0.018), equally the difference in pre and post intervention mean difference CPQoL (Family health) score (-3.41) was statistically significant ('t'= -3.3, SEM = 1.01, 'p' ≤0.003).

Adherence

All Twenty (100%) participants completed the full intervention resulting in a dropout rate of 0%. The mean attendance of offline sessions was 39.6 ± 5.13 days & similarly of online session was (68.1±32.81) as shown in table 1. The special educator and parents logged on to the website *(www.itelept.com)* to review the treatment protocols. The average duration of the session was 55-60 minutes.

Technical Feasibility

There were only two minor technical difficulties reported during the i-TelePT online exercise sessions, both relating to poor audio quality from a participant's device which was managed by the therapist speaking to the participants over the mobile. The bandwidth was not sufficient for two participants as living in remote areas or weathered conditions.

Safety & Adverse after effects (AAE)

No adverse events related to physical activity were noted during the study. However, one or two participants got some weather allergy and some participants got tired.

DISCUSSION

This study offers initial evidence on the practicality of providing physiotherapy services for children with cerebral palsy through telephysiotherapy in inclusive educational settings. This approach empowers special educators and utilizes available ICT resources. The study involved a well-structured eight-week telephysiotherapeutic intervention, which resulted in significant improvements in motor functions among children with CP, without any major adverse events. This adds to the growing body of evidence supporting the use oftelephysiotherapy as an adjunct for physical rehabilitation in the paediatric population. By utilizing available technology and empowering special educators, this approach can improve access to care and enhance outcomes for this population[22].

Results from present study do designate that i-TelePT being a newfangled and modern intervention technology was enormously feasible to all the children and the therapist. A school-based study conducted by (Rosie A Juliet et al., 2015) to determine feasibility of interactive virtual reality rehabilitation system for duration of 8 weeks for children with CP. The results of study showed that this system of rehabilitation is feasible in school based settings supervised by teachers supporting the present study in school environment[34].

Regarding pain outcome measures, our study found a significant reduction in pain levels. These results were compared to a study conducted by (Shambhu P Adhikari et al., 2020) which postulated that the use of telephone-based physiotherapy for pain management in resource-poor settings demonstrated a significant reduction in pain levels, supporting our findings[35]. Furthermore, our study showed that the balance and gross motor functions of children improved with preand post-intervention mean differences in PBS score (-3.55) and GMFM-88 total score (-9.7) respectively. This is consistent with a case study conducted by (Menici V et al.,2021) which demonstrated the feasibility of a telephysiotherapy over a period of three months, resulting in significant improvements in balance and postural control[36].

Participation of children with CP in school setting including curricular and extra-curricular activities requires optimal gross and fine motor function. The current study demonstrated significant improvements in fine motor skills, goal attainment and gross motor level at end of the 8 weeks of telephysiotherapy as compared. One study conducted by (Tamboosi et al., 2021) examined the effectiveness of tele-physiotherapy in CCP who have GMFCS levels I and II, and MACS levels I, II, and III. The findings of this study significantly support the current research outcome[37].

Equivalently, the mean score of GAS serves as an operational indicator of progress, revealing that children have successfully achieved their expected goals through individualized tele-physiotherapy sessions. Correspondingly, the spasticity in both upper and lower limbs showed dispersed improvement in muscle tightness that further supported with a evidence of TR resulted in improvement in spasticity among CCP[38] .

A study examined the feasibility of using virtual reality as an intervention to improve functional independence in CCP found positive results, supporting the use of TR as a beneficial intervention strategy. Additionally, review study reported the effectiveness of Virtual reality TR on hand functions recommend it as a beneficial strategy for children living in rural areas[39]. It is worth noting that a difference in functional independent measure was observed in all domains of WeeFIM, except communication in our study. This is likely due to the fact that no intervention related to communication or speech therapy was allocated by the researcher. However, a clinically significant difference was observed in FIM on all other sub domains. Therefore, TR may improve functional independence and daily activity for children living in both urban and ruralareas[37].

Similarly, QOL among CCP demonstrated significant improvements in all seven sub domains of CPQOL. In a study conducted by (Sgandurra G.,2018), the effectiveness of a Tele UPCAT system in home-based setting for children with unilateral CP , using CPQoL to observe an increase in the quality of daily activities [40]. The children with CP living in ru- ral areas were particularly enthusiastic about technological treatment at home, as they did not have to travel to a city clinic or hospital to receive this intervention. Therefore, physio- therapy intervention via online may improve QOL in CCP in inclusion education settings.

Due to the scarcity of literature on telephysiotherapy in schools, especially in inclusive settings for disabled students, this study on i-TelePT for children with CP in schools is a practical and beneficial approach to treatment.

CONCLUSION

Children with CP, who reside in remote and rural regions often, face a lack of access to physiotherapy services. This is especially crucial for children with CP, who may have limited mobility and require additional support to participate in physical activities. These children need physical independence at the school level, and telephysiotherapy can be used as an adjunct therapy. The results of this study demonstrate that i-TelePT intervention is not only feasible and safe but also leads to moderate to high levels of engagement and significant improvement. Our study highlights the potential benefits of incorporating telephysiotherapy into special education programs. These findings will encourage further exploration and implementation of this innovative approach.

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