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The Effect of Proposed Rehabilitation Exercises Combined with Medical Supports on Correcting Genu Varum and Improving Motor Balance in Children

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ABSTRACT
The aim of this study is to understand the effect of rehabilitation exercises combined with the use of medical braces on accelerating the correction of bow legs in children. The researcher adopted an experimental approach as it was appropriate to the nature of the study. A rehabilitation programme comprising a set of exercises designed to improve muscle balance and correct postural deviation was implemented, in conjunction with the use of medical braces. Pre- and post-intervention measurements of the study variables were taken, and the data were then statistically analysed. The results showed a marked improvement in the degree of bowlegs among the study participants following the implementation of the rehabilitation sessions, which indicates the effectiveness of rehabilitation exercises combined with medical braces in accelerating the correction process and improving children's postural alignment. The researcher recommends utilising this type of exercise in health and rehabilitation centres to treat cases of bow legs in children.

Keywords: Rehabilitation Exercises; Medical Supports; Bow Legs; Motor Rehabilitation; Postural Deformities.

ABSTRAK
Tujuan studi ini adalah untuk memahami efek latihan rehabilitasi yang dikombinasikan dengan penggunaan penyangga medis dalam mempercepat koreksi kaki melengkung pada anak-anak. Peneliti mengadopsi pendekatan eksperimental sesuai dengan sifat studi. Program rehabilitasi yang terdiri dari serangkaian latihan yang dirancang untuk meningkatkan keseimbangan otot dan memperbaiki penyimpangan postur diterapkan, bersamaan dengan penggunaan penyangga medis. Pengukuran variabel sebelum dan pasca-intervensi dilakukan, dan data kemudian dianalisis secara statistik. Hasilnya menunjukkan peningkatan yang signifikan dalam tingkat kaki melengkung di antara peserta studi setelah pelaksanaan sesi rehabilitasi, yang menunjukkan efektivitas latihan rehabilitasi yang dikombinasikan dengan penyangga medis dalam mempercepat proses

koreksi dan memperbaiki penyelarasan postur anak. Peneliti merekomendasikan penggunaan jenis latihan ini di pusat kesehatan dan rehabilitasi untuk mengobati kasus kaki melengkung pada anak-anak.

Kata Kunci: Latihan Rehabilitasi; Dukungan Medis; Kaki Busur; Rehabilitasi Motorik; Deformitas Postural.

INTRODUCTION

Genu varum (bow legs) is one of the most common postural deformities in children; it involves the legs turning outwards, causing the knees to splay apart when standing, whilst the ankles may touch or come close together (Killen & DeKiewiet, 2020, 2022). This bowing may be normal, associated with the child's developmental stages, or pathological, resulting from structural or nutritional disorders or abnormal bone growth (Gong et al., 2008; Sakamoto et al., 2020). If this deformity persists, it leads to an imbalance in the distribution of mechanical loads on the leg joints, which may cause walking difficulties, impaired motor function and an increased likelihood of joint problems in the future (Al Kaissi et al., 2006; Tang et al., 2025).

A study (Cashman, 2022) indicates that early intervention is one of the most important factors in correcting bow legs and limiting their progression, whereby rehabilitation exercises are used to improve muscular balance and increase the flexibility and strength of the muscles surrounding the lower limb joints, whilst orthotic supports help to realign the mechanical axis of the legs towards a normal position and reduce unbalanced stresses on the joints. From this perspective, the importance of combining rehabilitation exercises with orthotic supports has emerged as a non-surgical treatment aimed at accelerating the correction process and improving functional outcomes in children with bow legs (Deshpande et al., n.d.; Gong et al., 2008).

This study therefore aims to investigate the effect of proposed rehabilitation exercises combined with medical braces on accelerating the correction of bow legs in children and improving motor balance, thereby helping to provide a safe and effective treatment method that supports proper motor development and reduces future complications associated with this condition.

Research Problem:

Genu varum (bow legs) is a common condition in children, directly affecting their posture, gait and weight distribution across the leg joints. If left untreated, postural deformities may worsen and negatively impact the child's motor abilities and future health.

Through field visits conducted by the researcher and a review of cases at the Dijlah Government Rehabilitation Hospital in Salah al-Din Governorate, Tikrit, the researcher observed several children suffering from bowlegs to varying degrees. Furthermore, some cases relied on medical braces on an individual basis or engaged in unstructured physical activities without a comprehensive rehabilitation programme combining rehabilitation exercises and medical braces. Furthermore, there are still few local studies that have examined the effect of this combination on accelerating the correction of bowlegs in children.

The researcher therefore decided to introduce the proposed rehabilitation exercises alongside the use of medical braces to help accelerate the correction of

bowlegs and also to improve motor balance in children attending the government-run Dijlah Hospital in Salah al-Din Governorate, Tikrit, with the aim of reducing the bowing and helping to restore the lower limbs to their normal anatomical position.

Research objectives:

1. To develop proposed rehabilitation exercises, accompanied by medical braces, to correct bow legs and improve motor balance in children.
2. To investigate the effect of the proposed rehabilitation exercises, combined with medical supports, on correcting bow legs and improving motor balance in children.

Research hypotheses:

There are statistically significant differences between the pre-test and post-test results regarding the degree of bow-leggedness and motor balance in the children of the research sample, as a result of applying the rehabilitation exercises accompanied by medical supports, with the post-test showing better results.

Research Population:

1. Human scope: Children aged between 4 and 6 years with bow legs.
2. Temporal scope: From 1 September 2025 to 5 January 2026.
3. Geographical scope: The Government Medical Rehabilitation Hospital (Salah al-Din, Tikrit).

METHODS

Research Methodology

The researcher adopted an experimental approach as it was appropriate to the nature of the research problem and its objectives, using a single group design with pre- and post-test measurements (Bierer et al., 2025; Spurlock, 2018).

Research population and sample:

The research population consisted of children with genu varum (bow legs) who attended the Dijla Government Hospital in Salah al-Din Governorate, Tikrit, during the research period. The research sample was selected purposefully from children suffering from genu varum, numbering six children aged between 4 and 6 years, after confirming that their condition was suitable for participation in the proposed rehabilitation programme with medical support and that they met the study criteria. Two patients were selected as a pilot sample and were not excluded due to the specific nature of the sample and the difficulty in finding other patients within the same age group.

Homogeneity of the research sample:

Table 1. Homogeneity of the research sample in terms of variables (height, weight)

Statistical parameters Variables	Arithmetic mean (x)	Standard deviation (±σ)	Median	Skewness
Length (cm)	109.17	1.47	109.50	-0.62
Weight (kg)	18.50	1.05	18.50	0.00

As shown in Table (1), the skewness coefficients ranged from (-0.68) to (0.00), which falls within the statistically acceptable limits (±3). This indicates that the distribution of the sample is normal and that the sample is homogeneous with regard to the variables under study, thereby allowing for the appropriate statistical analyses to be carried out.

Methods of data collection: equipment and tools used in the research:
Methods of data collection:

1. Arabic and foreign scientific sources and references.
2. The Internet.

Research equipment and tools:
The researcher used the following equipment and tools:

1. An electronic medical scale to measure children's weight in kilograms.
2. A stadiometer to measure children's height in centimetres.
3. A flexible tape measure.
4. Specialised medical braces for correcting bow legs.
5. A mat or exercise rug for carrying out rehabilitation exercises.
6. Various balls and aids suitable for children of different ages.
7. Special forms for recording measurements and data.
8. A stopwatch to time exercises and rest periods.
9. A calculator and a computer for statistical processing and analysis of results.
10. A camera or smartphone to document the stages of implementation where necessary.

Tests used in the research:

A set of tests was used to measure the degree of outward bowing of the legs and motor balance; the tests were selected by the researcher through an analysis of scientific sources:
Test to measure the distance between the knees (Canale, 2021).
Purpose of the test: to measure the degree of genu varum (bow legs).
Unit of measurement: centimetres (cm).

Procedure: The child stands upright with their heels and ankles together; the distance between the medial condyles of the knees is then measured using a flexible measuring tape, and the distance is recorded in centimetres. A smaller distance between the knees indicates an improvement in the degree of bowing.
Test name: 10-metre walk test (O'Sullivan, 2019).
Purpose of the test: To measure motor balance in children.
Equipment required: Stopwatch, level floor.
Performance criteria: The child is asked to walk a distance of 10 metres and the time taken is recorded.
Pilot Study:

The researcher conducted the pilot study on a sample comprising two children from the same sample as the main research study, on Monday 1 September 2025, with the aim of verifying the suitability of the equipment and tools used and the feasibility of administering the tests and rehabilitation exercises, as well as identifying any obstacles and difficulties the researcher might face whilst conducting the main experiment.
The results of the pilot study revealed:

1. Confirmation of the suitability of the equipment and tools used for the measurements.
2. Identification of the time required to conduct the tests for each child.
3. Confirmation that the rehabilitation exercises were appropriate for the children's ages (4–6 years).

4. Verifying that the medical supports could be used safely and comfortably by the children.

Final procedures for the main trial:

Pre-test:

The researcher carried out initial examinations and measurements on the study group, consisting of six children aged between 4 and 6 years, on 5 September 2025, prior to the commencement of the rehabilitation exercises using medical supports. The measurements were carried out under the same conditions for all members of the sample, ensuring that the location, timing and instruments used were standardised, with the aim of obtaining accurate information reflecting the children's actual condition prior to the implementation of the rehabilitation exercises.

The pre-intervention tests included the following:

1. Measuring the distance between the knees when the heels are brought together.
2. A 10-metre walking test.

Proposed rehabilitation sessions:

The rehabilitation sessions continued for 12 weeks, with three sessions per week, bringing the total number of sessions to 36. Each session lasted between 35 and 45 minutes and was designed to suit the age characteristics of the children (4–6 years) with bow legs, with medical braces used throughout the duration of the rehabilitation sessions.

Components of the proposed rehabilitation sessions:

1. Warm-up section (10 minutes):

a. Light walking forwards and backwards.
b. Simple movement games.
c. Stretching exercises for the thigh and calf muscles.
d. Swinging movements of the arms and legs.

2. Main section (20–30 minutes):

a. Week 1–4: Preparation and adaptation phase:
    1) Walking in a straight line.
    2) Walking between spaced-out cones.
    3) Standing on one leg with assistance.
    4) Half squats.
    5) Lifting the heels and standing on tiptoes.
    6) Holding a ball between the knees and squeezing it.
    7) Stepping up onto and off a low platform.
    8) Static balance exercises.
b. Weeks 5–8: Strength and balance development phase:
    1) Sideways walking.
    2) Walking across a low balance beam.
    3) Full squats at a depth appropriate for the children's age.
    4) Resistance exercises using light elastic bands.
    5) Bridge exercises.
    6) Stair climbing exercises.
    7) Light jumping through hoops.
    8) Motor balance exercises.
c. Week (9–12): Functional development phase:

1) Light, progressive running.
2) Zigzag walking between cones.
3) Simple forward jumping exercises.
4) Standing on a foam balance pad.
5) Motor coordination exercises using balls.
6) Group movement games.
7) Exercises to strengthen the inner and outer thigh muscles.
8) Balance exercises.

3. Closing session (5 minutes):
   a. Simple relaxation exercises.
   b. Breathing exercises.
   c. Light stretching of the lower limb muscles.

Post-intervention tests:

The post-intervention assessment was conducted on 6 January 2026 following the completion of a three-month programme of rehabilitation sessions using medical aids for the research sample comprising six children aged between 4 and 6 years. The same tests used in the pre-intervention assessment were carried out under the same conditions, using the same procedures, tools and venue. These included measuring the distance between the medial condyles of the knees whilst the ankles were together, and assessing balance through a 10-metre walking test, with the aim of determining the extent of improvement in the degree of bow-leggedness resulting from the rehabilitation programme, and subsequently comparing the pre- and post-intervention measurement results using appropriate statistical methods to draw conclusions and achieve the research objectives.

Statistical Methods:

The data were analysed statistically using the Statistical Package for the Social Sciences (SPSS), where arithmetic means and standard deviations were used to describe the research sample data, and the skewness coefficient was used to examine sample homogeneity and normality of distribution, and the Paired Samples t-test to identify differences between the pre-test and post-test results.

RESEARCH RESULTS

The arithmetic means, standard deviations, calculated T-values and significance levels for the pre-test and post-test of the research variables are shown in

Table 2. Arithmetic means, standard deviations, calculated T-values and levels of statistical significance between the pre-test and post-test results for the measurement of the degree of bow-leggedness and the measurement of motor balance for the experimental group.

No	Variables	Unit of measurement	Pre-measurement		Post		Values	Moral moral e (sig)	Significance level
			S-	±A	S-	±A			
1	Degrees of outward	Second	6.83	0.75	3.17	0.75	8.94	0.000	Moral

	bowing of the legs								
2	Kinetic equilibrium	seconds	12.67	1.21	7.50	1.05	7.26	0.001	Subjective

The results of the t-test for paired samples showed statistically significant differences between the pre- and post-test measurements of leg bowing and motor balance, with the t-value for leg bowing (8.94) at a significance level of (Sig = 0.000), whilst the t-value for the motor balance test was 7.26 at a significance level of Sig = 0.001, which is below the significance level of 0.05. This indicates the effectiveness of the proposed rehabilitation exercises in reducing the degree of bow-leggedness and improving motor balance.

DISCUSSION

The research findings revealed statistically significant differences between the pre-test and post-test in the variables of the degree of bow-leggedness and motor balance, in favour of the post-test, which indicates the effectiveness of the rehabilitation programme, supported by medical aids, in improving the condition of the children in the study sample. The researcher attributes this improvement to the positive effect of the rehabilitation exercises, which targeted the muscles acting on the knee and hip joints, as well as their role in improving soft tissue flexibility and increasing the strength of the muscles responsible for maintaining the correct anatomical position of the lower limbs. Regular therapeutic exercises lead to functional and motor adaptations that contribute to the correction of postural deviations and the improvement of motor performance (Kisner et al., 2022; Al-Khayyat and Hassanein, 2018).

Furthermore, orthoses have helped to provide continuous mechanical support to the lower leg, thereby helping to guide the feet into correct alignment and reduce postural deviations resulting from the legs turning outwards. This confirms that early intervention during childhood supports better therapeutic outcomes due to the musculoskeletal system's capacity for adaptation and growth at this age (O'Sullivan et al., 2019; Ratib, 2017).

As for the motor balance variable, the improvement observed in the post-test can be explained by the fact that the rehabilitation exercises included motor activities that helped develop neuromuscular coordination and improve the function of deep sensory receptors, which positively influenced the children's ability to control their body posture during movement and maintain stability whilst performing various motor tasks, Furthermore, the improvement in lower limb alignment led to better body weight distribution and a reduction in the mechanical imbalance that had previously adversely affected motor balance (Magee, 2021; Abdel Fattah, 2015).

The research findings are consistent with the observations of Kendall and colleagues (Kendall et al., 2005) that muscular balance around the joints is a key factor in maintaining correct body posture and enhancing the efficiency of movement; any improvement in muscle strength and flexibility directly affects the efficiency of motor performance and balance, as explained by Mohamed Sobhi Hassanein (2014) that targeted motor programmes help to enhance basic motor skills and improve motor control in children.

Furthermore, the study's findings are consistent with the observations of Campbell, Palisano and Orlin (Campbell et al., 2017) that rehabilitation programmes tailored for children play an important role in improving motor skills and coordination abilities, particularly when designed according to the developmental characteristics of the target age group. Al-Alawi and Mufti Ibrahim (2016) also noted that increasing motor loads and selecting appropriate exercises contribute to positive adaptations that help improve functional performance and reduce postural problems.

Accordingly, the researcher believes that the improvement in the degree of bow-leggedness and motor balance is attributable to the combination of rehabilitation exercises and orthotic devices, as the exercises helped to improve functional and muscular aspects, whilst the orthoses provided the necessary mechanical support and guidance to correct postural deviation. This led to the achievement of the rehabilitation programme's objectives and an improvement in the motor function of the children in the study sample. This is consistent with the findings of Arab and international studies in the field of motor rehabilitation and physiotherapy (Kisner et al., 2022; O'Sullivan et al., 2019; Al-Khayyat and Hassanein, 2018; Abdel Fattah, 2015).

CONCLUSIONS AND RECOMMENDATIONS

Conclusions:

1. Rehabilitation exercises supported by medical aids contributed to a significant improvement in the degree of bow-leggedness among the children in the study sample, indicating their effectiveness in helping to correct postural deviation.
2. Rehabilitation exercises supported by medical aids led to an improvement in motor balance among the study participants, as evidenced by the significant differences between the results of the first and second tests.
3. The combination of rehabilitation exercises and orthotic devices is an effective approach for accelerating the rehabilitation process and improving the functional and motor abilities of children with bow legs.

Recommendations:

1. Rehabilitation exercises combined with medical aids should be adopted in rehabilitation and physiotherapy centres to correct bow legs in children.
2. Emphasise the importance of early detection of bow legs and undergoing appropriate rehabilitation exercises to prevent the condition from worsening and to achieve better treatment outcomes.
3. Conduct future studies examining the effect of rehabilitation exercises combined with medical braces on larger samples and different age groups, using additional variables and tests to support research findings in this field.

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