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Comparing the Effectiveness of Patellar Bracing with Conventional Exercises to Occupation-Based Intervention with Conventional Exercises in Managing Patellofemoral Pain Syndrome in Athletes

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Abstract

Introduction: Patellofemoral Pain Syndrome (PFPS) is a prevalent lower extremity condition observed in physically active individuals, characterized by diffuse anterior knee pain without the presence of intra-articular damage or a specific mechanism of injury. The heterogeneity in symptom presentation poses a challenge, with activities like squatting and stair climbing triggering knee pain. **Aim & Objectives:** To evaluate and compare the efficacy of patellar bracing combined with conventional therapeutic muscle strengthening exercises against occupation-based intervention along with conventional therapeutic muscle strengthening exercises in the management of Patellofemoral Pain Syndrome in athletes.

Material and Methodology: Group A received therapeutic muscle strengthening exercises with a Patellar Brace, while Group B received Occupation-Based Intervention (OBI) along with therapeutic muscle strengthening exercises. Both groups underwent a 12-week management program, with evaluations conducted at baseline, 6 weeks, and 12 weeks.

Result: The data was tested for normality using the Kolmogorov-Smirnov Z test with $p < 0.05$. Repeated measures ANOVA was used for mean pre and post comparison within group and mean and mean changes between groups. The level of significance was set at $p < 0.05$.

Conclusion: In conclusion, findings indicate that both approaches are effective, but Occupation-Based Intervention (OBI) combined with Therapeutic Muscle Strengthening Exercises proves significantly more effective than Patellar Brace with Therapeutic Muscle Strengthening Exercises.

Keywords: Patellofemoral Pain Syndrome, Occupation-Based Intervention (OBI)

Introduction

Patellofemoral Pain Syndrome (PFPS) is a prevalent lower extremity condition observed in physically active individuals, characterized by diffuse anterior knee pain without the presence of intra-articular damage or a specific mechanism of injury. The heterogeneity in symptom presentation poses a

challenge, with activities like squatting and stair climbing triggering knee pain. Studies indicate that approximately 7.8% of the general population has received a PFPS diagnosis, with higher prevalence rates among sporting and recreationally active individuals, reaching up to 25%. Notably, 75% of those with PFPS modify or cease their activities due to persistent pain, and recurrence rates are as high as 90%.

The impact of patellofemoral pain extends beyond short-term limitations, affecting long-term social participation. Patients report pain persisting for up to 4 years after symptom onset, with 25% experiencing significant symptoms even 20 years later. Females, especially young athletes, exhibit a higher incidence of anterior knee pain (10%) compared to their male counterparts (7%). Among athletes, PFPS accounts for a substantial proportion of knee injuries, constituting 33% in female athletes and 18% in males.

While numerous studies have explored conservative management techniques for PFPS, there lacks a consensus on the most effective approach. Current strategies encompass a variety of therapeutic techniques, including knee and hip muscle strengthening exercises, bracing, orthotics, electrical stimulation, open and closed chain exercises, and kinesio taping. However, limited attention has been given to the Occupational-Based Intervention (OBI) approach in the treatment of knee pathology. OBI, a fundamental element of occupational therapy management, remains underutilized in the context of knee pathology, despite its potential as a remediation agent when combined with conventional strengthening exercise programs.

This study aims to contribute to the evidence base for OBI in the management of knee pathology, exploring its effectiveness when integrated into a comprehensive therapeutic regimen. By investigating the impact of OBI alongside conventional strengthening exercises, the study seeks to enhance our understanding of its role in restoring physical functions related to knee pathology.

Aim & Objectives

To evaluate and compare the efficacy of patellar bracing combined with conventional therapeutic muscle strengthening exercises against occupation-based intervention along with conventional therapeutic muscle strengthening exercises in the management of Patellofemoral Pain Syndrome in athletes.

Material and Methodology

The research work obtained permission and approval from the head of the institution and the institutional ethical committee. The study design was experimental, interventional, and comparative, with simple random sampling used as the sampling method. The study took place at a tertiary care hospital and research center, focusing on individuals with a history of sport, athletic, and recreational activity participation who were diagnosed with Patellofemoral Pain Syndrome (PFPS).

The study's duration was 18 months, conducted in the Occupational Therapy department at a tertiary clinical setup. The inclusion criteria encompassed individuals aged 18 to 45 years with unilateral knee involvement and duration of pain since one month. Exclusion criteria included a history of traumatic knee injury, knee effusion, inflammatory joint pathology, infection, lower extremity fracture, and congenital deformities of the knee and ankle, with no bilateral knee involvement.

The outcome measures involved using the Canadian Occupational Performance Measure (COPM) to assess performance and satisfaction. After obtaining permission, patients diagnosed with PFPS from the

Ortho OPD of GMCH Nagpur were screened, and those meeting the inclusion criteria and willing to participate were selected.

Patients were explained the study's purpose and methodology, informed about risks, and made aware of their right to terminate participation at any time. All patients provided signed consent forms. Demographic details and a brief history of PFPS were collected. Using simple random sampling, patients were divided into two groups (Group A and Group B).

Group A received therapeutic muscle strengthening exercises with a Patellar Brace, while Group B received Occupation-Based Intervention (OBI) along with therapeutic muscle strengthening exercises. Both groups underwent a 12-week management program, with evaluations conducted at baseline, 6 weeks, and 12 weeks.

The OBI, a less resource-intensive rehabilitation program, incorporated patient-centric training based on the PEO Model. It focused on individualized rehabilitation, decision-making on occupation-based goals, and activities mimicking ADL and I-ADL. OBI aimed to reduce fear associated with disablement and included patient education on foot-knee-hip alignment, pain management, and gradual return to sport.

The intervention emphasized activity modification, load management, and a pain-monitoring model for athletes to gradually return to sport. Participants progressed through a preplanned model, starting with warm-up and gradually increasing participation time based on pain tolerance.

Result

The data was analyzed statistically by using GraphPad InStat-3 softwares. Various statistical measures such as mean, standard deviation (SD), range, tests of significance and 95% Confidence interval were used for this purpose. The data was tested for normality using the Kolmogorov-Smirnov Z test with $p < 0.05$. Repeated measures ANOVA was used for mean pre and post comparison within group and mean and mean changes between groups. The level of significance was set at $p < 0.05$.

Figure 1a: Pie Chart illustrating the age-group-wise distribution of therapeutic muscle strengthening exercises along with Patellar Brace in Group A.

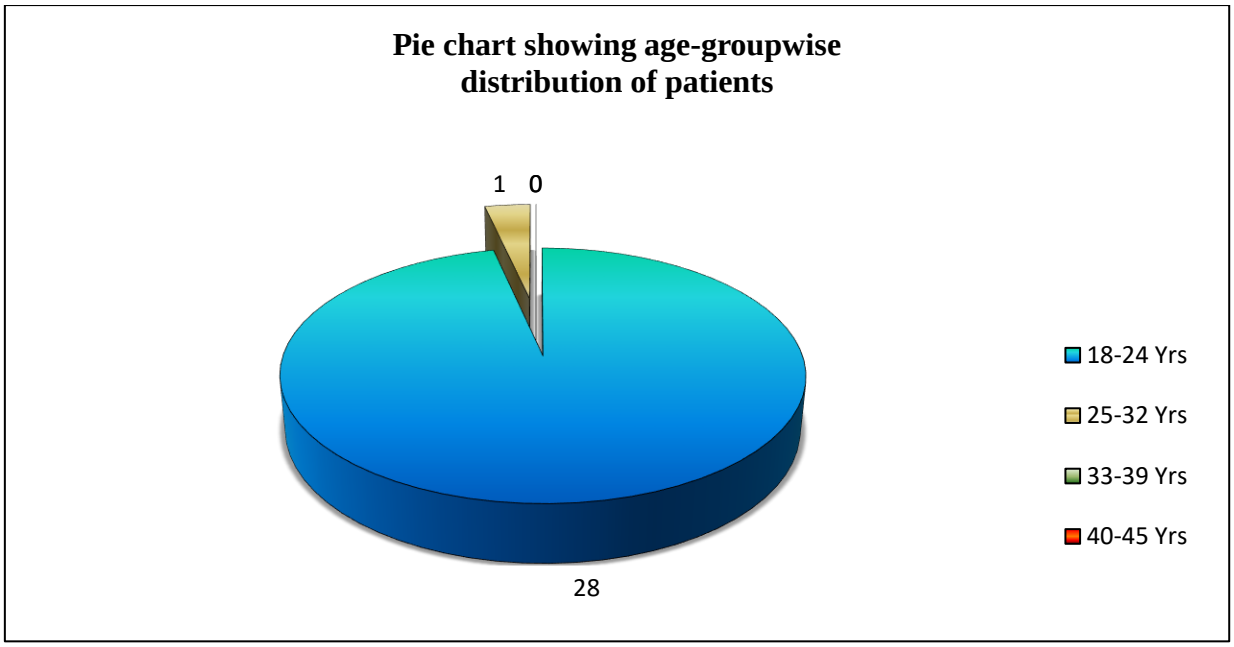

Figure 1b: Pie chart showing age-group wise distribution of patients receiving occupation based intervention along with the therapeutic muscle strengthening Exercises (Group B).

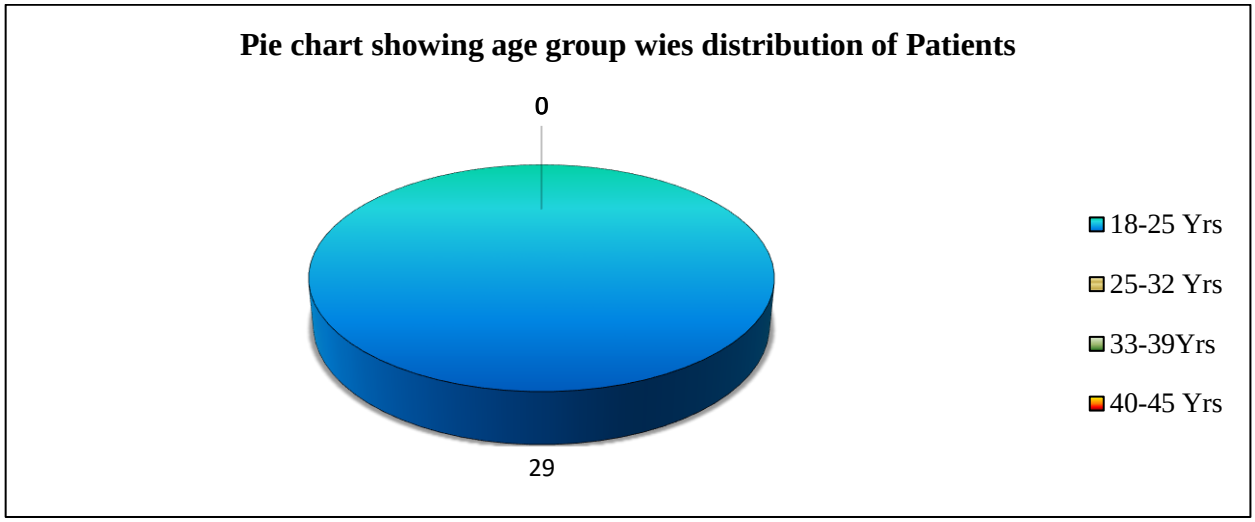

Table1: Tablet illustrating the age-group-wise distribution of therapeutic muscle strengthening exercises along with Patellar Brace in Group A and patients receiving occupation based intervention along with the therapeutic muscle strengthening Exercises (Group B).

Age-group	Group A		Group B	
	No. of patients	**Percentage**	**No. of patients**	**Percentage**
18-24	28	96.55%	29	100%
25-32	1	3.45%	0	0%
33-39	0	0%	0	0%
40-45	0	0%	0	0%
Total	29		29	
Mean±SD	21.41 ± 1.65		20.48 ± 1.61	

Figure 2a: Pie chart showing percentage of gender distribution in Group A.

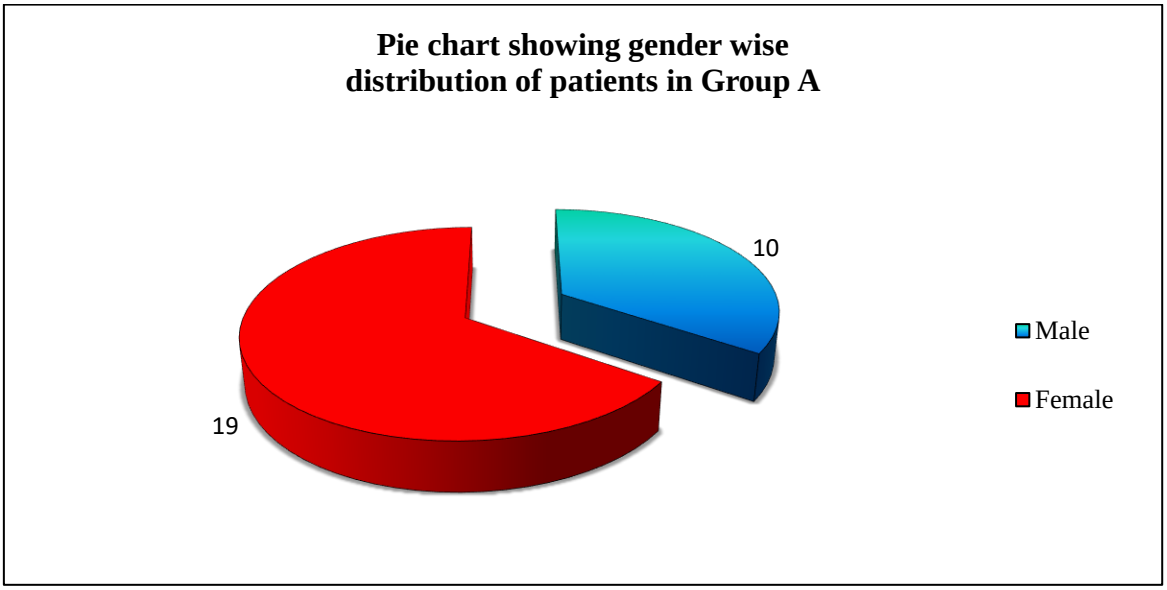

Figure 2b: Pie chart showing percentage of gender distribution in Group B.

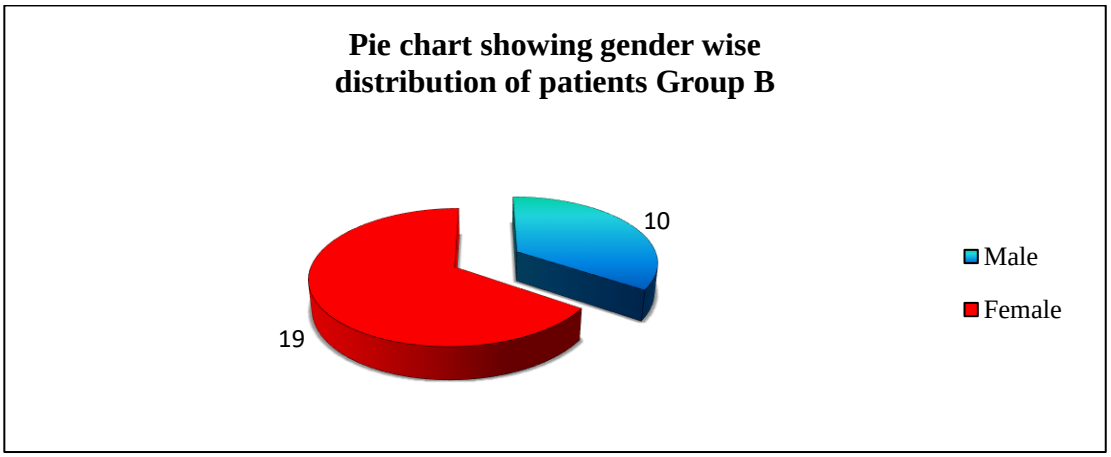

Table 2: Distribution of subjects according to gender in group A and Group B.

	Group A			Group B		
	Males	Females	Total	Males	Females	Total
Number	10	19	29	10	19	29
Percentage (%)	34%	66%	100%	34%	66%	100%

Graph 3:- Showing comparison of mean COPM performance component for Group A and Group B

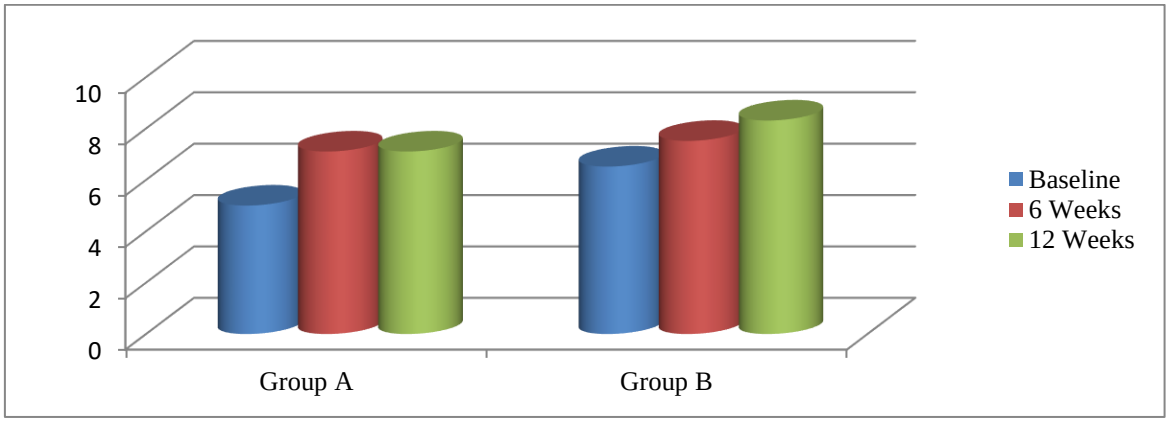

Table 3:- Showing comparison of mean COPM performance component for Group A and Group B

	Group A			Group B		
	Baseline	**6th Week**	**12th Week**	**Baseline**	**6th Week**	**12th Week**
Mean	5	7.103	7.103	6.517	7.517	8.310
Std. Deviation	0	± 0.8170	± 0.8170	± 0.1617	± 0.8710	± 0.6603
P value	Baseline Vs 6th Week P < 0.001*** Baseline Vs 12th Week P < 0.001*** 6th Week Vs 12th Week P > 0.05 NS			Baseline Vs 6th Week P < 0.001*** Baseline Vs 12th Week P < 0.001*** 6th Week Vs 12th Week P < 0.01**		

Graph 4:- Showing comparison of mean COPM Satisfaction component for Group A and Group B.

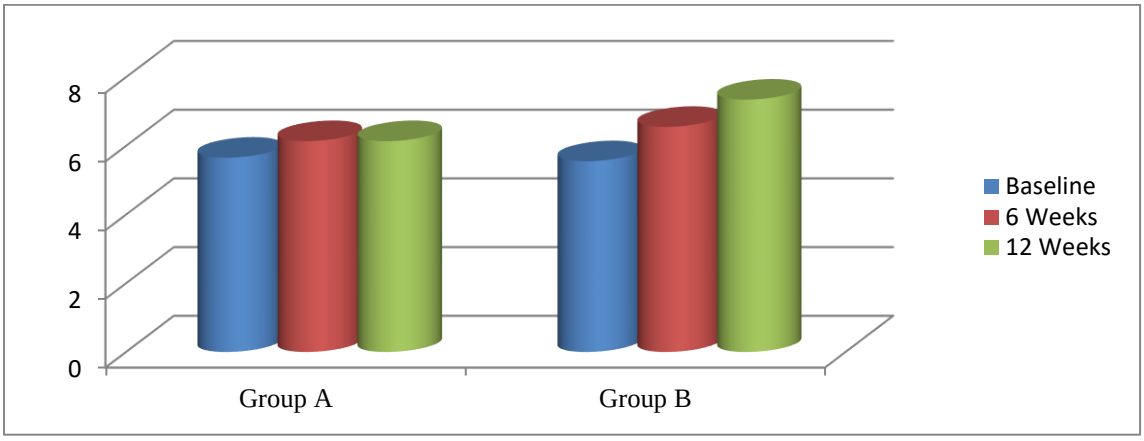

Table 4:- Showing comparison of mean COPM Satisfaction component for Group A and Group B.

	Group A			Group B		
	Baseline	**6th Week**	**12th Week**	**Baseline**	**6th Week**	**12th Week**
Mean	5.655	6.138	6.138	5.552	6.552	7.345
Std. Deviation	± 1.203	± 0.9151	± 0.9151	± 0.9482	± 0.9482	± 0.7209
P value	Baseline Vs 6th Week P < 0.001*** Baseline Vs 12th Week P < 0.001*** 6th Week Vs 12th Week P > 0.05 NS			Baseline Vs 6th week P < 0.001*** Baseline Vs 12th Week P < 0.001*** 6th week Vs 12th Week P < 0.001***		

Discussion:

In Group A, comprising 29 patients aged 18 to 45, 96.55% were in the 18-24 age group, with only one patient (3.45%) in the 25-32 range and none in 33-39 and 40-45. For Group B, with the same total and age range, 100% were in the 18-24 group, with no representation in 25-32, 33-39, and 40-45. Graph 1 and Table 1 illustrate this distribution. The mean age for Group B was 20.48 ± 1.61 years. Baseline demographics were comparable between groups. This aligns with Benjamin E. Smith et al.'s (2018) findings on patellofemoral pain prevalence among young individuals and highly active populations. Our study echoes these trends, with most patients in the 18-24 age group, emphasizing the association of patellofemoral pain with overuse injuries and increased physical activity.

The study found that both groups showed immediate and long-term improvement in the performance and satisfaction components of athletes at 6 and 12 weeks, as indicated in Tables 3 & 4 and Graphs 3 & 4. However, the improvement in the performance and satisfaction of the Occupation-Based Intervention (OBI) group was significantly greater than that of Group A, with $p < 0.001$. This improvement was sustained in both intervention groups during follow-up sessions, suggesting the retention of benefits. Notably, the occupation-based intervention group consistently outperformed the therapeutic muscle strengthening training and patellar brace group, indicating superior generalization and transfer of learning. Participants in the occupation-based intervention group reported significantly higher scores for their own perception of performance and satisfaction (Canadian Occupational Performance Measure) compared to Group B.

Our study aligns with David L. Nelson et al.'s exploration of Therapeutic Occupation/Occupation-based intervention. In his work, he expands upon the definition of occupation as the connection between various forms of occupation and occupational performance. The article delves into terms like meaning, purpose, developmental structure, impact, and adaptation, elucidating how they pertain to therapeutic occupation, a distinct occupational category. Therapeutic occupation, achieved through occupational synthesis, is central to occupational therapy, involving the collaborative design of occupational forms by therapists and recipients to facilitate therapeutic evaluation or attain therapeutic goals. Therapeutic occupation encompasses meaningful, purposeful occupational performance, incorporating assessment, adaptation, and compensation within the context of occupational synthesis. This concept is intricately linked to contemporary frames of reference and models of practice in occupational therapy.

The etiology of patellofemoral pain syndrome (PFPS) remains unclear, displaying a multifactorial nature. Patients commonly exhibit weaknesses in quadriceps and hip musculature, altered lower extremity kinematics, reduced flexibility, and psychosocial stressors [2, 25]. Merzenich and Jenkins have underscored the significance of training behavioral state and reinforcement strength, the positive impact of meaningful stimuli, and diverse stimulus patterns in cortical plasticity [7, 10, 19, 24]. Additional factors contributing to functional improvement include engaging the injured limb in meaningful activities, intensifying focus and attention on the affected limb, and enhancing inputs from the affected limb to the brain [7, 10, 19, 24].

Notably, the occupation-based intervention group experienced a crucial benefit by incorporating natural contexts, encompassing real and familiar environments, objects, people, and meaningful occupations. This group demonstrated sustained improvement during follow-up sessions. Natural contexts offer a structured, meaningful, and enriched support system that promotes optimal performance, along with enhanced motor skill retention and transfer [7, 24].

The sustained improvement observed in the occupation-based intervention group during follow-up sessions yields a significant contrast with the therapeutic exercise group utilizing a patellar brace. The hypothesis posits that emphasizing functional activities leads to substantial functional improvement but has a minimal impact on impairment, while concentrating on impairment brings about reductions in impairment levels with a lesser impact on function [12, 15].

Another contributing factor to this improvement is the motivation of participants in the occupation-based intervention group to utilize their affected limb more during various daily activities and ground physical training. Active engagement in a client-centered program tailored to individual occupational priorities, needs, and interests may enhance functional outcomes and overall health [11, 14, 24]. In occupation-based intervention, emphasis on multidimensional and meaningful goals contrasts with rote exercises that focus on individual movements, stretching, or strengthening exercises. This difference in approach strongly influences motor learning, leveraging the brain's multimodal capacity by engaging multiple senses simultaneously [10, 16, 21].

While some studies report no significant effect of bracing on patellar alignment, others demonstrate associations between patellofemoral bracing and decreases in lateral patellar translation under static conditions, as well as improvements in knee stability and pain during dynamic loading [5, 18, 22]. Current literature suggests additional mechanisms by which patellofemoral knee braces may alleviate symptoms, including dissipation of lateral forces, increased patellofemoral contact area, decreased contact pressure, unloading of the knee extensor mechanism, and psychological effects such as improved confidence [5, 9,

[14]. The findings collectively propose that bracing employs diverse strategies beyond patellar tracking correction to reduce patellofemoral pain symptoms, influencing pressure distribution on the patella.

Conclusion:

In conclusion, findings indicate that both approaches are effective, but Occupation-Based Intervention (OBI) combined with Therapeutic Muscle Strengthening Exercises proves significantly more effective than Patellar Brace with Therapeutic Muscle Strengthening Exercises. Patients in the OBI group exhibit increased motivation for engaging the affected limb in daily activities, leading to enhanced and expedited recovery while reducing the overall treatment duration.

Limitations and Recommendations:

- Study conducted in a single geographical area.
- Future studies should include participants from diverse sports backgrounds, such as indoor games, cricket, kho-kho, kabaddi, karate, badminton, volleyball, basketball, etc.
- Subsequent research should encompass both rural and urban sports facilities and environments.
- Integration of Occupation-Based Intervention (OBI) in sports rehabilitation is recommended for prolonged and enhanced benefits, aiding athletes in continuous training and faster recovery.

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