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Knee bracing vs Taping as an Adjunct to Rehabilitative Exercise in Patellofemoral Pain Syndrome Management among Basketball Players: A Prospective Study

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Abstract

Patellofemoral pain syndrome (PFPS) is a common source of knee problems found mostly in physically active young adults. Causative factors are multifactorial, including lower extremity weakness, especially quadriceps muscles. Conservative treatment of PFPS consists mainly of knee bracing and knee taping combined with physical therapy. This study was aimed to analyse the outcome comparison between knee bracing and knee taping in combination with rehabilitative exercise for PFPS management. A prospective study was performed involving twenty-five basketball players suffering from PFPS, aged 19–30 years old with regular practice sessions. The subjects were each grouped randomly into a taping or a bracing group. Follow-up evaluations in term of Kujala patellofemoral score were done in the 1st, 2nd, and 4th weeks after treatment. Unpaired t-test and chi-square were used to analyse the difference between both groups in pre- and post-intervention. Baseline characteristics of each group did not differ significantly ($p>0.05$). Both groups had significantly higher functional scores after the 1st, 2nd, and 4th weeks of intervention ($p<0.05$). Significantly higher functional scores were found in the bracing group on the 2nd ($p=0.013$) and 4th weeks ($p=0.002$). No significant differences were found in functional scores between both groups in the 1st week ($p=0.142$). While both methods were efficacious, knee bracing is more effective compared to knee taping in improving functional outcomes as an adjunct to rehabilitative exercise in PFPS management.

Keywords: *patellofemoral, taping, bracing, exercise, Kujala score*

Introduction

Patellofemoral pain syndrome (PFPS) is defined as pain of the anterior knee joint and/or soft tissues surrounding the knee joint. It is a commonly found cause of knee pain in physically active young adults (Aghapour, Kamali, & Sinaei, 2017). As has been mentioned by Crossley et al. (2016) and Logan et al. (2017), the syndrome is characterized as pain in the anterior patellar or retropatellar region, which worsens during physical activity, such as squatting, running, and extended sitting sessions. Higher prevalence of PFPS was found in athletes that participate in sports that require rapid hip adduction and internal rotation and subsequent knee abduction and external rotation, such as basketball (Almeida et al., 2015; Petersen, Rembitzki, & Liebau, 2017; Powers, Bolgla, Callaghan, Collins, & Sheehan, 2012; Willy et al., 2019). In one study (Willy et al., 2019), the aetiology of PFPS is thought to be poorly understood and considered to be multifactorial, including anatomical derangements, decreased muscle strength, even pain sensitization and psychological factors. Witvrouw, Lysens, Bellemans, Cambier, and Vanderstraeten (2000) also summarized that a decreased quadriceps flexibility, a

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shorter reflex response time of the vastus medialis oblique muscle, a reduction of vertical jump height, and higher than normal medial patellar mobility is associated with PFPS occurrence.

Management of PFPS may be initiated conservatively or surgically; the former is the first-line of treatment, with the latter only initiated if the prior conservative treatment had failed to alleviate the symptoms related to PFPS (Barton, Lack, Hemmings, Tufail, & Morrissey, 2015; Petersen et al., 2017). Doyle (2000) stated that conservative treatment of PFPS consists mainly of rehabilitative exercise. The goal of muscle strengthening and exercises is to address muscle performance deficits, movement coordination deficits, and mobility impairments (Willy et al., 2019). Several immobilization techniques have been introduced for reducing pain during functional tasks, such as patellar taping and knee bracing. Knee bracing redistributes loads to the entire joint and may alleviate pain associated with PFPS. Knee taping functions as a limiter to patella movement during rehabilitation and aids in the movement of the oblique vastus medialis during physical activity. Both of the methods have limitations; knee taping was proven to be efficacious in the short term (<4 weeks), yet its long-term efficacy has yet to be studied; knee bracing is the most recent addition to the alternative to treating PFPS, as such, limited data were available in terms of efficacy in comparison to the knee taping (Willy et al., 2019).

Recent published studies have implied that there is insufficient data regarding the optimal immobilization technique for PFPS. According to our literature review, no prior studies focused on the efficacy of knee bracing and taping combined with rehabilitative exercise, specifically evaluated according to an assessment tool such as the Kujala patellofemoral score (Kujala et al., 1993). This study aimed to analyse the comparison in efficacy between knee bracing and knee taping, both in combination with rehabilitative exercise, in managing PFPS, specifically in basketball athletes.

Methods

A prospective randomized study was performed in basketball players with PFPS as the target population. The Independent variable was the immobilization technique, either taping or knee bracing, and the dependent variable was the Kujala patellofemoral score. Variables collected in the study included baseline characteristics and baseline functional score.

The Kujala score is a self-administered questionnaire consisting of thirteen questions regarding knee pain symptoms (Table 1), six of which were associated with individuals with PFPS. The score range from 0 to 100; a higher score indicates a higher functional score (Kujala et al., 1993). The inclusion criteria of the study were basketball athletes that practice regularly (at least 3 times a week), aged 19–30 years old, body mass index of 18.5 to 24.9 kg/m^2, confirmed PFPS diagnosed prior to the study, and baseline Kujala score of 50–70. In this study, we used the Indonesian version of the Kujala score, as developed by Mustamsir et al. (2020). The subject would be excluded from the study if he had a previous history of other knee injuries (dislocation and/or fracture of the knee joint), congenital disease, an autoimmune disease of the knee joint, infectious disease of the knee joint.

Table 1. Kujala patellofemoral score chart

Variable	Score	Variable	Score
		Prolonged sitting with the knees flexed	
Limp		No difficulty	10
None	5	Pain after exercise	8
Slight or periodical	3	Constant pain	6
Constant	0	Pain forces subject to extend knees temporarily	3
		Unable	0
		Pain	
Support		None	10
Full support without pain	5	Slight and occasional	8
Painful	3	Interferes with sleep	6
Weight-bearing impossible	0	Occasionally severe	3
		Constant and severe	0
		Swelling	
Walking		None	10
Unlimited	5	After severe exertion	8
More than 2 km	3	After daily activities	6
1-2 km	2	Every evening	4
Unable	0	Constant	0
		Abnormal painful kneecap movement (subluxations)	
Stairs		None	10
No difficulty	10	Occasionally in sport activities	6
Slight pain when descending	8	Occasionally in daily activities	4
Pain both when descending and ascending	5	At least one documented dislocation	2
Unable	0	More than two dislocation	0
		Atrophy of thigh	
Squatting		None	5
No difficulty	10	Slight	3
Repeated squatting painful	4	Sever	0
Painful each time	3		
Possible with partial weight bearing	2		

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Variable	Score	Variable	Score
Running			
No difficulty	10	Flexion deficiency	
Pain after more than 2 km	8	None	5
Slight pain from start	6	Slight	3
Severe pain	3	Severe	0
Unable	0		
Jumping			
No difficulty	10		
Slight difficulty	7		
Constant pain	2		
Unable	0		

Total score: 95–100 Excellent; 800–94 Good; 60–79 Fair; 0–60 Poor

A simple random sampling of amateur basketball athletes with PFPS in Bandung was performed. Each participant was assigned to either bracing using LP 758 Open Patella Knee Support (Trans-Global Sports, United Kingdom) or taping (BSN Leukotape, Essity, Sweden), as shown in Figure 1. The knee tape was applied in a standard patellofemoral fashion, directly to the skin starting from outside of the patella and with a little tension secure to the inside of the knee. The knee taping applications were performed by a single physician (H.R.P). Patients in both groups also received similar rehabilitative exercise, as prescribed by the Department of Physical Medicine and Rehabilitation, Hasan Sadikin General Hospital, which included the hip- and knee- targeted exercises. Knee-targeted exercise includes either weight-bearing (resisted squats) or non-weight-bearing (resisted knee extension) exercise.

FIGURE 1. Application of (A) knee bracing; (B) knee taping

The minimum sample required for the study was calculated using the Gay and Diehl formula; the minimum sample size of 30 samples (each group consisted of 15 samples) were required to obtain a study with 80% power. Descriptive and analytical statistics were used for data analyses in this study. Descriptive statistics were used to describe both groups' numerical and categorical variables (baseline and after intervention). Mean, standard deviation, median, and range were used to describe numerical data. A Shapiro-Wilk test was used to determine data normality. Comparison between both groups would be analysed using a Mann-Whitney test in non-normally distributed data; an unpaired t-test was used if the data were normally distributed. Comparisons between both sets of categorical data were analysed using the chi-square test. A p-value of <0.05 was deemed statistically significant.

This study was approved in advance by the Hasan Sadikin Hospital - Research Ethical Committee, Bandung, Indonesia (Registration No. LB.02.01/X.6.5/190/2020). Each participant voluntarily provided written informed consent before participating.

Results

Twenty-five subjects were included in this study, comprised of twelve patients in the taping group and thirteen patients in the bracing group. Baseline characteristics of both groups (Table 2) showed an insignificant difference in terms of age, affected side, and baseline Kujala score ($p>0.05$).

In both groups, significantly increased Kujala scores were found throughout the duration of the follow-up in the 1st, 2nd, and 4th weeks after treatment ($p<0.05$). Comparisons be-

Table 2. Baseline characteristics

Variables	Taping	Bracing	p-value
Age (years)	28.83±2.125	27.23±2.385	0.090
Affected side (N)			0.543
Left	7 (58.3%)	6 (46.2%)	
Right	5 (41.7%)	7 (53.8%)	
Kujala score (baseline)	68.67±3.985	68.85±3.484	0.781

tween both groups were performed in terms of Kujala score throughout the aforementioned follow-up period; taping and bracing did not differ significantly in terms of Kujala score after one week of intervention (p=0.142); the bracing group had a higher score compared to the taping group. On the 2nd (p=0.013) and 4th weeks (p=0.002), significantly higher Kujala scores were found in the bracing group compared to the taping group (Table 3).

Table 3. Functional outcomes

Kujala score (follow-up)	Taping	Bracing	p-value
1st week	71.75±3.980	74.31±4.385	0.142
2nd week	74.50±5.161	80.46±3.971	0.013
4th week	79.00±5.510	86.69±3.815	0.002

Discussion

Muscle strength imbalances, particularly of the lower extremities, may contribute to the development of PFPS by causing instability of patellar bone towards the femur, specifically during lateral movement, due to the weakness of vastus medialis oblique muscle (Lankhorst, Bierma-Zeinstra, & van Middelkoop, 2013). Associated with the relatively benign prognosis of the syndrome, treatment is mostly composed of conservative therapies. Knee taping or bracing are treatment modalities used in combination with rehabilitative exercises as the first-line, non-pharmacological treatment (Crossley et al., 2016; Willy et al., 2019).

Taping is an option to improve patellar tracking within the patellofemoral groove for PFPS management, as introduced by McConnell (1986). Quadriceps muscle weakness had been known to result in malposition of the patella and subsequently affect the muscle's ability to produce force (Kaya, Doral, & Callaghan, 2012). Lu, Li, Chen, and Guo (2018) proposed kinesio-taping as an effective rehabilitation modality used in musculoskeletal system. Thus, knee taping was associated with higher functional scores after intervention for patients with PFPS in terms of pain severity, muscle strength, joint position sense, static and dynamic balance compared to the functional scores before usage and compared with a placebo group (Aytar et al., 2011; Bicici, Karatas, & Baltaci, 2012). However, taping is not without weakness. The effectiveness of the taping procedure depends on many variables. Many years ago, Rarick, Bigley, Karst, and Malina (1962) raised the concern that athletic tape would lose 40% of its initial support after 10 minutes of exercise. The relative motion of the superficial skin layer in relation to the subcutaneous tissue can limit the tape effectiveness, as can sweating.

Knee bracing provides support to the knee joint by increasing the compression force of the knee joint and aids in the redistribution of the force to the knee joint. Knee bracing functions in preventing excessive lateral movement and aids in patellar realignment. Patellar alignment of the knees may also be repaired in patients using knee braces. An external compression force provided by the knee brace may prevent further maltracking of the patella, which may require surgical intervention to repair (Petersen et al., 2017; Willy et al., 2019). Braces are designed to overcome many of the problems related to conventional taping. The fabric used in the brace is stronger than the athletic tape, as reported by Hall, Simon, and Docherty (2016).

In this study, both methods were equally efficacious in increasing the functional score of patients with PFPS; both groups had significantly higher functional score starting from one week of use up to four weeks of use; in all follow-up time points (1st, 2nd, and 4th weeks), functional scores were significantly higher compared to the baseline Kujala score. This study noted that the difference in efficacy in alleviating pain related to PFPS was higher in the knee-bracing group than the knee-taping group on the 2nd and 4th weeks. A previous study concluded that patellofemoral knee orthoses did not have a meaningful effect on pain in the short term (Smith, Drew, Meek, & Clark, 2015). However, the same review had also noted the very low quality of evidence and heterogeneity of the braces' types. This study attempted to give an additional perspective on a focused comparison between certain type of braces and tapings, using a clinical scoring tool.

The study is a prospective study; as such, it can be inferred that the clinical efficacy of each method can be followed longitudinally at different time points. Despite its advantage as a prospective study, the study design had several limitations. First, this study was performed with a relatively small sample size, which risks type II statistical errors and may have resulted in some variations failing to reach statistical significance. Second, the underlying comorbidities, complications, and satisfactions were not explored sufficiently to be included in the assessments. Third, the study could not be blinded to the authors because the physicians had to treat the patients directly. Additionally, the follow-up duration of four weeks was relatively short. Despite its limitations, this study had provided information to be utilized in improving functional outcomes in a specific subset of locally based basketball athletes. Further studies should include longer follow-up to identify the mid-term and long-term effects of both methods.

Exercise and knee support usage are effective in achieving satisfactory outcomes by PFPS treatment indicated by Kujala

scores. During exercise, knee bracing is found to be more effective compared to knee taping in improving functional outcomes in basketball athletes with PFPS. This result was attributable to a more stable and durable construct of knee bracing in comparison with taping, which was conducive to rehabilitative exercise. Further studies with larger sample sizes and longer follow-up durations may be required to ascertain whether the effects can be persistent until the condition fully heals.

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Conflict of Interest

The authors declare that there is no conflict of interest.

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