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Case Series

Tibial tubercle osteotomy (Fulkerson procedure) on women athlete with anterior knee pain: a case series

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ABSTRACT

Anterior knee pain (AKP) is one of the most frequent complaints in knee conditions of adolescent and young adult patients. Tibial tuberosity osteotomy (Fulkerson procedure) is a well-described treatment option for a broad range of patellofemoral joint disorders. This study aimed to evaluate the clinical outcomes of tibial tubercle osteotomy and prognostic factors correlated with the outcomes in adolescents' athletes affected by anterior knee pain. Three patients treated with tibial tubercle osteotomy for anterior knee pain were prospectively evaluated using the Anterior Knee Pain Scale (AKPS), The Western Ontario and McMaster Universities Arthritis Index (WOMAC) and the part of the International Knee Documentation Committee (IKDC) score to find different potential risk factors as an objective evaluation. The three cases are showing improvement in overall scores, both in six months (WOMAC 72.4; KUJALA 64.6%; IKDC 52.1%) and after one year (WOMAC 82.6; KUJALA 83.3%; IKDC 70.3%) following the surgical procedure. Patient 1 and patient 2 obeyed the physiotherapy schedules and checked their condition regularly. Their scores indicate an immense improvement than patient 3, who did not comply with the physiotherapy nor the check-up. However, the comparison analysis shows a significant increase of the scores for all three assessment methods (WOMAC, KUJALA and IKDC), that implies a good result of clinical outcome may still be achieved even without a close follow up. Even though the Fulkerson procedure was the treatment option for a broad range of AKP, a different comprehensive range result of the scores was found.

Keywords: Fulkerson, Anterior knee pain, Tibial tubercle osteotomy

INTRODUCTION

Anterior knee pain (AKP) is one of the most common causes for adolescent and young adult patients to seek medical help for knee problems, accounting for up to 74% of knee pain in adolescents who participate in sports.[1] Due to a variety of factors, it frequently becomes a difficult clinical problem. At a study conducted in a sports medicine clinic, Nejati et al discovered that 16.7% of people have AKP.[2] Women had a 2.23 times greater incidence of AKP than men, indicating that gender is a significant predictor of AKP development. In women, the prevalence of anterior knee pain ranges from 13% to 27%.[1]

Both the orthopaedic surgeon and the physiotherapist find it difficult to treat patients with AKP. Collins et al discovered that 40% of AKP patients had an unsatisfactory recovery 12 months after their initial diagnosis.[3] Furthermore, 70 to 90% of people with AKP experience recurrent or chronic pain.[4] AKP causes psychological restrictions and handicap, which may be due to psychological affectation rather than pain.[5] Because AKP

has a complicated etiology, each patient's treatment must be tailored to their specific needs. There are a few surgical treatments available if conservative care fails to relieve patellofemoral pain. Despite appropriate nonoperative treatment (i.e., NSAIDs, brace, physical therapy, injection, taping), surgery is recommended for recurrent patellar dislocations. Tibial tuberosity osteotomy (the Fulkerson procedure) is a well-known treatment modality for a variety of patellofemoral joint problems.[6]

Despite the variety in measurement findings, multiple earlier case series have reported that the Fulkerson procedures demonstrated a high proportion of outstanding results and considerable improvements in objective, subjective, and functional parameters.[7,8] The goal of this study is to evaluate clinical outcomes of post tibial tubercle osteotomy (Fulkerson procedure) in adolescent athletes affected by anterior knee pain. In this report, three cases of post-Fulkerson's procedure were assessed using three questionnaires, namely, the Anterior Knee Pain Scale (AKPS), known as "the Kujala score", The Western Ontario and McMaster Universities Arthritis Index (WOMAC) and the part of the International Knee Documentation Committee (IKDC) score. The article will describe the comparison of the clinical outcome scores before and after the operation.

CASE SERIES

Case 1

A 17 years old female, is a basketball player and a high school student.

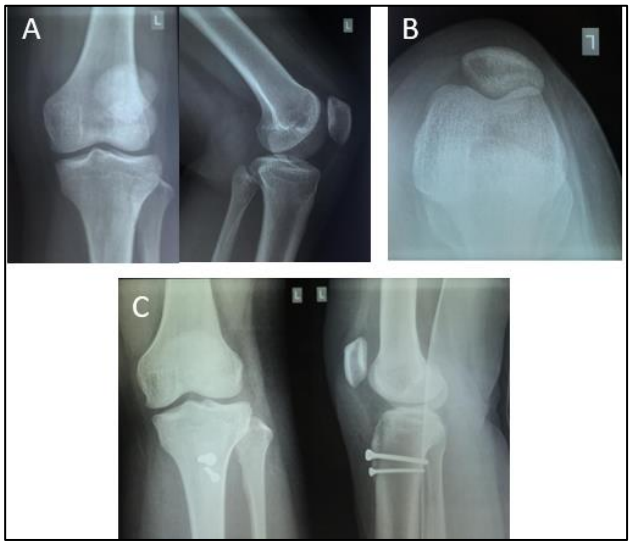

Figure 1: A 17 years old female with AKP. (A) Plain radiograph pre-operative AP, lateral: no abnormalities appeared left knee. (B) Plain radiograph skyline view: suspect subluxation left patella. (C) Plain radiograph post-operative AP, lateral: screw insertion in left proximal tibia.

She complained about pain in her left knee after a sports accident. She was diagnosed with AKP and performed the surgery on October 4, 2018. Following the surgery, the patient did physiotherapy and got check-up regularly. She reported that the pain gradually decreased one year later.

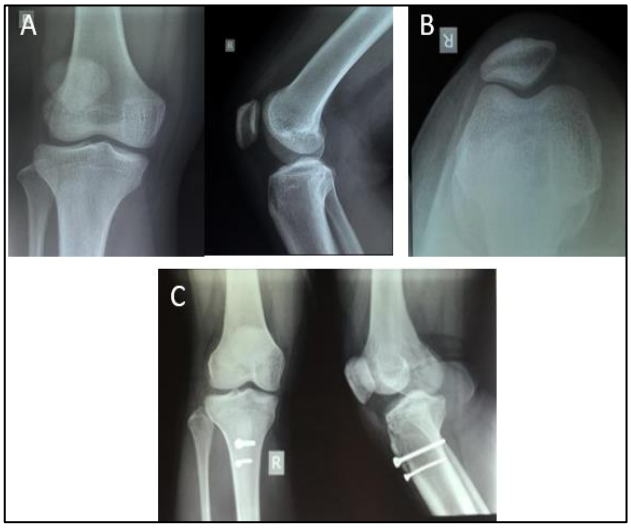

Figure 2: A 19 years old female with AKP. (A) Plain radiograph pre-operative AP, lateral: no abnormalities appeared right knee. (B) Plain radiograph skyline view: suspect subluxation right patella. (C) Plain radiograph post-operative AP, lateral: screw insertion in right proximal tibia.

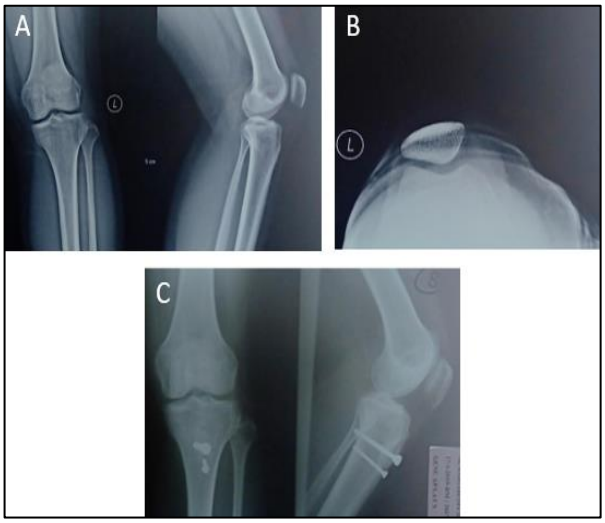

Figure 3: A 34 years old female with AKP. (A) Plain radiograph pre-operative AP, lateral: Osteoarthritis left knee. (B) Plain radiograph skyline view: no abnormalities appeared. (C) Plain radiograph post-operative AP, lateral: screw insertion in left proximal tibia.

Case 2

A 19 years old female, is a runner and a high school student. She complained about pain in her right knee after

a sports accident. She was diagnosed with AKP and performed the surgery on January 15, 2019. Following the surgery, the patient did physiotherapy and got check-up regularly. She reported that the pain gradually decreased one year later.

Case 3

A 34 years old female, is a runner and an insurance officer. She complained about pain in her left knee after a sports accident. She was diagnosed with AKP and performed the surgery on January 18, 2018. Following the surgery, the patient did not do physiotherapy nor got check-up. After a year, she reported that the pain is endurable and does not require medicine, but the symptoms persisted.

RESULTS

A total of three cases were diagnosed with AKP and treated with surgical management using the Fulkerson procedure. All three cases were female, athletes (runner and basketball player), with a mean age of 25.5 (range from 17 to 34). All the cases were diagnosed and did the surgery about a year ago.

Table 1: Patient characteristics and clinical outcome scores in three assessment methods.

Variable	Patient ID		
	Patient 1	**Patient 2**	**Patient 3**
Characteristics			
Age	17 y.o.	19 y.o.	34 y.o.
Gender	Female	Female	Female
Activity	Student, basketball player	Student, runner	Insurance officer, runner
Assessment methods			
WOMAC			
Before surgery	50.3	40.8	38.2
6 months evaluation	80.3	73.5	63.6
1 year evaluation	90.6	89.1	68.2
KUJALA			
Before surgery	52%	42%	37%
6 months evaluation	72%	70%	52%
1 year evaluation	95%	93%	62%
IKDC			
Before surgery	40.2%	35.6%	32.2%
6 months evaluation	60.9%	48.3%	47.1%
1 year evaluation	88.5%	87.4%	55.2%

Table 2: Methodology.

Methods	Freq.	Mean±SD	ΔMean	P value*
WOMAC				
Before surgery	3	43.1±6.4	Ref**	
6 months of evaluation	3	72.5±8.4	29.4 (68.2%)	0.001
1 year evaluation	3	82.6±12.5	39.5 (91%)	
KUJALA				
Before surgery	3	0.44±0.1	Ref**	
6 months evaluation	3	0.65±0.1	0.21 (47.7%)	0.005
1 year evaluation	3	0.83±0.2	0.39 (88.6%)	
IKDC				
Before surgery	3	0.36±0.04	Ref**	
6 months evaluation	3	0.52±0.1	0.16 (44%)	0.014
1 year evaluation	3	0.80±0.2	0.44 (122%)	

*P value based on repeated measure test on each method. ** Reference group

The study observed the clinical complaints pre-operative and post-operative using three different kinds of questionnaires (i.e., WOMAC score, KUJALA Score, and IKDC Score) prospectively. The characteristic of the cases and each assessment score described in Table 1 by three specific observation times (before surgery, after six months and after one year).

The result shows gradual improvement in overall scores of all patients after six months and one year following the surgery using Fulkerson procedure. In one year following the surgery, assessment of the clinical outcome of patient 1 resulting in the highest scores (WOMAC 90.6; KUJALA 95%; IKDC 88.5%), while patient 3 has the lowest score of all three (WOMAC 68.2; KUJALA 62%; IKDC 55.2%). The comparison analysis of each assessment method by the observation time described in Table 2.

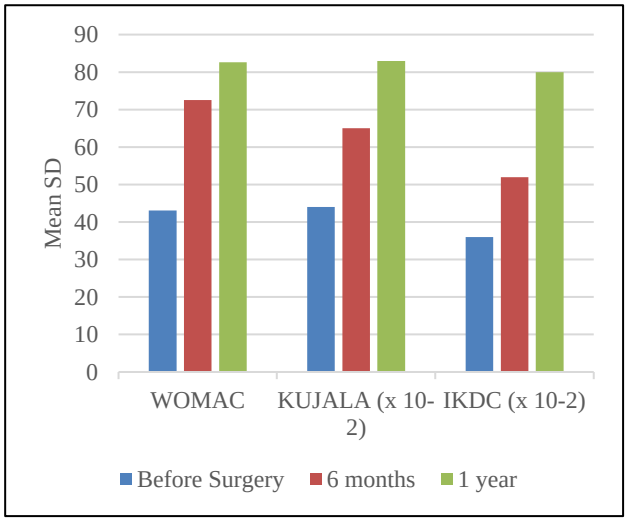

Figure 4: Comparison of follow-up clinical outcome scores in three assessment methods.

The comparison analysis using repeated measure test (ANOVA) shows a significant difference in clinical outcome scores of all patients after six months and one-year evaluation. The WOMAC score improved by nearly 30 points 6 months after surgery, and 40 points 1 year after surgery. Meanwhile, the Kujala score improved by nearly 50% and 90%, 6 months and 1 year after surgery, respectively. Likewise, IKDC score even showed greatest improvement of all scoring systems. Each assessment method shows an improvement in the mean difference; approximately doubled from before surgery overall scores. The details of the score is also depicted in Table 2.

DISCUSSION

The three cases of interest presented a gradual improvement in overall scores after one year of follow up. The Fulkerson's procedure once again showing a good result in three cases of AKP in this study. Despite having some variation in the evaluation scores, the repeated measures test showing a significant increase of the scores to all assessment questionnaire.

AKP is a relatively common disorder encountered in the clinical setting for adolescent and young adult patients, and even more frequent in the adolescent who is participating in sports.[9] Anterior knee pain has a wide range of symptoms and is an approved and accepted term among clinical researchers. Anterior knee pain does not signify a specific diagnosis or physical condition and is likely multifactorial. Grelsamer et al estimated that the prevalence of AKP in childhood and adolescence at 19%, although the prevalence estimates generally cited in the published literature vary widely, from 3% to 40%.[10] Nejati et al found the prevalence rate of AKP to be 16.7% in a study performed in a sports medicine clinic.[2] Boling et al found a prevalence of 15% in women and 12% in men.[11] They also observed that the annual incidence of AKP was 33 of 1000 people in female patients, but only 15 of 1000 people in male patients. Gender is a significant predictor for the development of AKP, with women having an incidence of 2.23 times higher than that of men. However, the incidence of AKP in the general population is unknown. Since AKP frequently occurs in working young adults, it has a meaningful societal impact due to work absences and lost productivity and the economic expense involving in treating these patients.[12]

Treating patients with AKP is often frustrating, for both the orthopaedic surgeon and the physiotherapist. Collins et al have shown 40% of unfavourable recovery at 12 months after the initial diagnosis.[3] Moreover, between 70% and 90% of individuals with AKP have recurrent or chronic pain. AKP provokes both psychological limitations and disability, which may arise more from the psychological affectation than from the pain itself.[13]

Given that the etiology of AKP is multifactorial, individualized treatment must be tailored to the patient.14 When conservative management fails to improve the patellofemoral pain, a few surgical options exist. Surgery is indicated for recurrent patellar dislocations despite adequate nonoperative treatment (i.e., NSAIDs, brace, physical therapy, injection, taping). Tibial tuberosity osteotomy (Fulkerson procedure) is a well-described treatment option for a broad range of patellofemoral joint disorders.[15,16] Multiple case series have reported the Fulkerson procedures. Despite the heterogeneity in outcome measurements, results demonstrate a high percentage of excellent good results and improvements in the objective, subjective, and functional measures.[7]

Three questionnaires were used in this study. The Western Ontario and McMaster Universities Arthritis Index (WOMAC) is widely used in the evaluation of knee osteoarthritis since the future complications of AKP was OA. It is a self-administered questionnaire consisting of 24 items divided into three subscales: Pain, Stiffness, and Physical activity. IKDC and Kujala Score were tools for

evaluating clinical outcome measures for sports-related knee injuries.

In the descriptive result, the three cases showing improvement in overall scores, both in six months (WOMAC 72.4; KUJALA 64.6%; IKDC 52.1%) and after one year (WOMAC 82.6; KUJALA 83.3%; IKDC 70.3%) following the surgical procedure. Patient 1 and patient 2 obeyed the physiotherapy schedules and checked their condition regularly. Their scores indicate a higher improvement than patient 3, who did not comply with the physiotherapy nor the check-up. However, the comparison analysis shows a significant increase of the scores for all three assessment methods (WOMAC, KUJALA and IKDC), that implies a good result of clinical outcome may still be achieved even without a close follow up.

CONCLUSION

Even though the Fulkerson procedure was the treatment option for a broad range of AKP, a different wide range result of the scores was found. We believe many factors influence these results, such as level of compliance to do physical therapy and follow-up evaluation.

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