Isokinetic evaluation of knee extensor/flexor muscle strength in Behcet's patients

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ABSTRACT

Background: Behçet's disease (BD) is an idiopathic, multisystemic, progressive disease. The purpose of this study is to compare the knee flexor and extensor isokinetic muscle strengths of Behcet's patients with that of healthy subjects.

Methods: Twenty-five (13 male and 12 female) patients with BD and 25 (15 male and 10 female) healthy individuals were included in the study. Velocities of 90°/sec, 120°/sec, and 150°/sec were used for the isokinetic muscle strength testing. Patients with active inflammatory knee arthritis were excluded. Peak torque (Nm) and peak torque adjusted to body weight (%) were taken into consideration for comparison between study groups.

Results: Compared to healthy controls, there was a statistically significant decrease in both the bilateral knee extensor and flexor muscle isokinetic peak torques (Nm) as well as the peak torques adjusted to body weight (%) at velocities of 90°/sec, 120°/sec and 150°/sec in patients with BD ($p < 0.05$). However, there was no significant difference in the agonist-antagonist ratio of the isokinetic peak torques of knee muscles between the two groups.

Conclusion: In light of these findings, we have concluded that both knee flexor and extensor isokinetic muscle strengths are lower in BD. We therefore recommend careful monitoring of patients with BD in terms of muscle strength.

Keywords: Behçet's disease; Knee; Muscle strength; Isokinetic; Peak torque.

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INTRODUCTION

Behçet's disease (BD) is a chronic, multisystemic inflammatory disease, characterized by recurrent orogenital aphthous ulcerations, uveitis and skin lesions. The disease may affect other systems such as locomotor, neurological, gastrointestinal, nephrologic and vascular systems[1,2].

Arthritis has been found present at the time of diagnosis in about 70% of patients, and 9% of patients have had arthritis only as an initial manifestation in BD. The most frequently involved joints are the knees, ankles, wrists, and elbows[3]. The arthritis of BD is usually mono-oligo or polyarticular, and it characteristically manifests a nondestructive course[4].

Isokinetic muscle strength (IMS) is a measure of the maximal dynamic muscle strength throughout the range of motion in a joint. Considered to be a valid and reliable measure[5,6], IMS is often used to evaluate sports performance and the efficacy of exercise training in sports medicine, as well as to evaluate the efficacy of surgical intervention and rehabilitation in orthopedic and rehabilitation clinics[7-9]. In recent years it has also been used for the evaluation of muscle strength in rheumatological diseases associated with functional disabilities[10,11]. In a recent study, quadriceps muscle strength was measured with isokinetic dynamometer in rheumatoid arthritis (RA) and ankylosing spondylitis (AS) patients who had low disease severity and suffered little knee pain during the walking exercise[11].

The involvement of the knee joint in BD is well-

known; however, to our knowledge, until now there have not been any studies in the literature which relate BD to the strength of the knee muscles. Motivated by this, our study was conducted in order to measure knee flexor and extensor muscle strength in patients with BD by using an isokinetic dynamometer, and to compare the results of the measurements with those obtained for an age- and sex-matched healthy control group. In that respect, this study is the first controlled study to evaluate knee flexor and extensor isokinetic muscle strength in patients with BD.

MATERIALS AND METHODS

The study was designed as a cross-sectional, controlled, clinical study. We included 25 (13 male and 12 female) consecutive patients presenting at the Physical Medicine and Rehabilitation and Dermatology Departments, and diagnosed with BD according to the International Study Group for BD criteria[12]. The same number of healthy disease-free individuals (15 male and 10 female) were included to serve as controls. Each participant provided written informed consent to participate in this study, which was also approved by the local ethics committee.

The patients were evaluated from the systemic, rheumatologic, dermatologic, ophthalmologic, and neurologic points of view. The patients were screened for age, sex, weight, height, and the durations of disease. We excluded from the study all patients and healthy subject' s with any known neurologic, orthopedic, cardiovascular, pulmonary disease, diabetes mellitus, or any thyroid disorders that may have an effect on muscle strength. Moreover, we excluded those patients with active inflammatory knee joint involvement. None of the patients had neurologic involvement and active uveitis. None of the individuals had engaged in a regular exercise program for the last 6 months. The overall incidence of joint symptoms and the involved joints were recorded. None of the patients were using medications that affect muscle strength either positively or negatively. Arthralgia was defined by physical examination as pain in the joint without demonstrable inflammation. The healthy volunteers were selected among relatives of the patients admitted to our clinic.

Before the formal testing, each subject performed a warm up on a bicycle ergo meter with a load of 1 W/kg and with stretching exercises of the lower limbs for 5 minutes. We used a calibrated isokinetic testing dynamometer (Biodex System 3 Pro, Biodex Corp., Shirley, NY) for isokinetic muscle strength testing of the trunk. The reliability of the isokinetic testing is estimated to be r=0.97 for the quadriceps femoris muscles and r=0.85 for the hamstring muscles[6]. The reliability and reproducibility of the device used, is well established[13].

The procedure to measure the knee flexor and extensor isokinetic muscle strength of each subject was as follows: Firstly, the subject was seated upright on the Biodex chair with the axis of the dynamometer aligned to the knee joint axis. Once positioned properly, the subjects shoulder, waist, thigh, and lower right leg proximal to the ankle were secured with straps. The subject was then instructed to perform concentric knee exercise at a range of motion (ROM) from 0° to 90° of flexion. Five warm-up and practice repetitions were performed before each testing repetition. The isokinetic testing protocol consisted of tests at three angular velocities of 90°, 120° and 150°/sec, with 10 repetitions. The initial five repetitions at each velocity were performed at sub maximal effort, and the last five were performed at maximum effort. There was a 5 minutes of rest interval between successive repetitions (Figure 1). All tests were performed on both extremities and performed for concentric muscle strength. Peak torque (PT), peak torque/body weight (PT/BW) ratio (%) and the agonist/antagonist (flexor/extensor) ratio (%) (AG/AN) were recorded. PT is the highest torque value obtained from the measurements in all joint action distinction. There are multiple parameters in the isometric measurements evaluating muscle strength and

FIGURE 1. Isokinetic knee muscle strength testing with Biodex System 3 Pro dynamometer

muscle function. Among those parameters, PT isometric test parameter, whose unit is newtonmeter (Nm), is the most suitable and is highly recommended[14]. PT is affected by age, gender, dominant extremity, BMI, body fat ratio, and waist thickness. PT/BW is a parameter that is used for commenting on the isokinetic evaluation and making the measurements subjective and unique to the person[15]. AG/AN ratio evaluates the balance of trunk flexor and extensor[16].

The software SPSS 16.0 (SPSS, Chicago, IL, USA) was used for statistical evaluation. Whenever variables were normally distributed, as assessed using the Kolmogorov-Smirnov test, we performed parametric test statistics; such as independent sample t-test. For the categorical variables, we used the Chi-square test. The data were expressed as mean ± standard deviation for parametric variables and as frequency (count or percent) for categorical variables. All p values less than 0.05 were considered to indicate significance.

TABLE I. DEMOGRAPHIC CHARACTERISTICS OF PATIENTS WITH BEHCET'S DISEASE AND CONTROLS

	BD patients	Controls	
	n = 25	n = 25	P
Age (years)	34.72±9.21	33.24±9.01	0.568
Gender (M/F) (n)	13/12	15/10	0.569*
Weight (kg)	71.96±14.07	68.48±8.93	0.302
Height (cm)	168.20±8.92	167.80±7.26	0.877
BMI (kg/m^2)	25.30±3.60	24.27±2.29	0.238
Dominant side (R/L)	22/3	24/1	0.297*
Disease duration (years)	8.25±6.38		

Data presented as mean ± S.D.
*Chi-Square test

RESULTS

The mean age of the patients was 34.72 ± 9.21 (range 22-52), and that of the controls was 33.24 ± 9.01 (range 23-57) years. Therefore, there was no statistically significant difference between the two groups in age. Likewise, no statistically significant difference was detected in weight, height and BMI either. The mean duration of disease was 8.25 ± 6.38 (range 0.5-25) years for the BD group. Descriptive characteristics of the patient and control groups are presented in Table I.

Up to the examination date, only 6 patients had never experienced any joint complaints. Among the remaining 19 patients, 9 had had inflammatory arthritis anamnesis. On the date of examination, none of the patients had active inflammatory knee arthritis. However, 2 patients had active joint inflammation in the elbow. In the BD group, 11 subjects had anterior or posterior uveitis; among these subjects, 2 patients had bilateral involvement. For all patients with uveitis, the disease was under control with medical treatment.

The control group exhibited statistically significantly greater strength at velocities of 90°/sec, 120°/sec and 150°/sec both for the right (p = 0.001, 0.006 and 0.007 respectively) and left (P = 0.006, 0.009 and 0.016 respectively) knee extensors. Isokinetic knee flexor strength was significantly lower at 90°/sec and 120°/sec for the right knee ($p < 0.001$, = 0.025 respectively) and at 90°/sec for the left knee (p = 0.046) in the BD group (Figure 2). All extensor PT/BW ratios (%) of the knee strengths at velocities of 90°/sec, 120°/sec and 150°/sec were significantly lower ($P < 0.001$ for all comparisons) in the BD group. Behçet's patients group exhibited statistically significantly lower PT/BW ratio (%) at velocities of 90°, 120° and 150°/sec both for the right ($p < 0.001$, = 0.003 and = 0.005 respectively) and the left (p = 0.005, 0.016 and 0.012 respectively) knee flexors (Figure 3). However, the difference between bilateral knee agonist-antagonist ratios (%) of isokinetic peak torques of the two groups was not significant at any of the velocities (Figure 4).

DISCUSSION

In this study, we aimed to investigate bilateral knee flexor and extensor muscle strength at velocities of 90°/sec, 120°/sec and 150°/sec, by using isokinetic methods, in patients with BD. We included patients who had never had active inflammatory arthritis up to the time of the examinations. We compared the patient's results with age- and sex-matched controls. The isokinetic measurements at the three velocities revealed that both PT and PT/BW were significantly lower in Behcet's patients. However, no significant difference, was observed between the two groups in the agonist--antagonist ratios of the knee muscles, which suggest that in BD there is a relationship between the muscle strength loss in the anterior and posterior musculature.

In diseases associated with joint involvement both

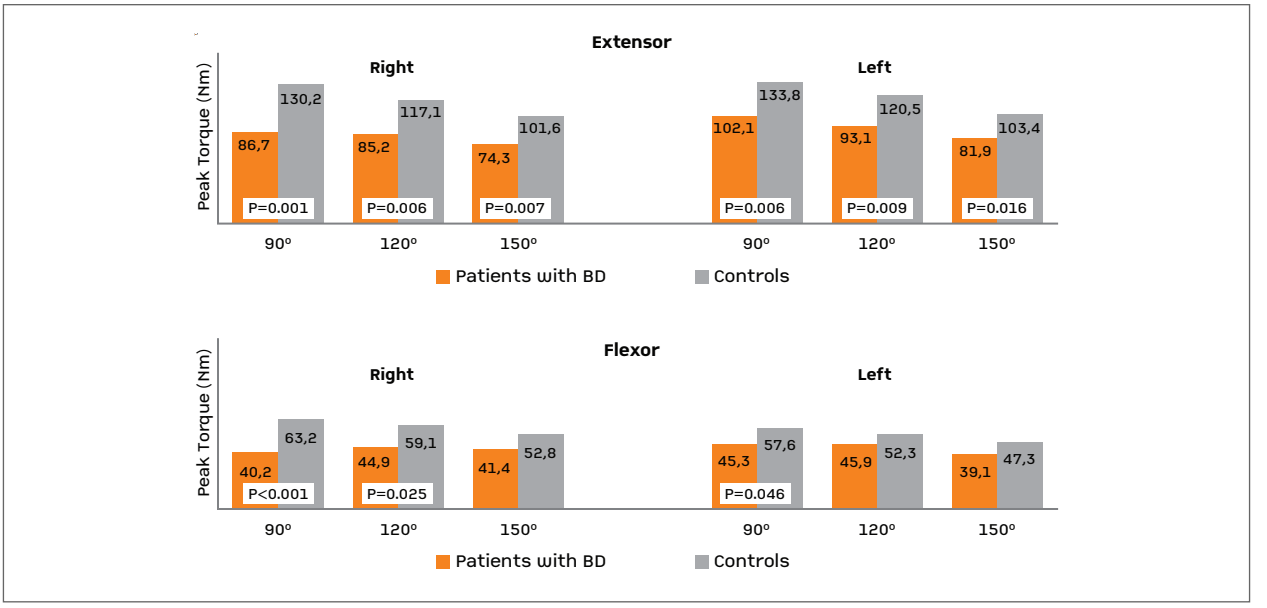

FIGURE 2. Peak torque of flexor and extensor knee isokinetic muscle strength in patients with BD and healthy subjects

immobilization and functional disabilities, as well as inflammation in joints and periarticular tissues, may lead to a decrease in muscle strength[10,17]. In prospective studies, the incidence of arthralgia or arthritis in BD is observed in more than half of patients[18,19]. In Behcet's patients, lower extremity joint involvement, particularly knee involvement, is common and is seen with remissions and activations[4]. In a recent study, involvement of the knee was reported to be found in 40% of patients with BD[20]. In our study, arthralgia and/or arthritis anamnesis was present in 13 (52%) BD patients, but none of those patients had active inflammatory knee arthritis.

BD is a multisystemic disease, thus many factors may lead to functional disability in patients. Uveitis is a common and important clinical finding during the follow-up of BD. The frequency of ocular involvement in patients with BD is around 70%. The typical form of ocular involvement is a relapsing remitting uveitis. Less frequently, it may present in the form of conjunctivitis, conjunctival ulcers, keratitis, episcleritis, scleritis, and extra ocular muscle paralysis from neurologic involvement of BD. Intraocular inflammation may involve the anterior or posterior segment or, more commonly, both segments[21]. In a study involving patients with AS, the presence of acute anterior uveitis (AAU) in AS patients was reported to lead to a significant decrease in the patients' functionality in daily activities. It was suggested that the presence of AAU in AS patients may be associated with higher disease activity, poor functional ability and advanced physical impairment[22]. In our study, none of the patients has active intraocular inflammation; however, 11 (44%) patients have experienced uveitis attacks in their medical anamnesis and uveal inflammation was clinically under control with medication.

In BD, other probable causes of muscle weakness could be nervous system involvement and muscular tissue inflammation. Although central nervous system involvement is well described in BD; in recent studies, an axonal type of distal sensory or sensorimotor polyneuropathy predominantly involving the lower extremities has been commonly reported in BD patients[23,24]. Silent neurologic involvement may occur in BD, and there is a possibility of subclinical involvement without neurologic signs and symptoms in some cases[23]. In this study, despite the lack of electromyogram (EMG) results, we performed neurologic examinations thoroughly. We could not detect any signs of peripheral or central nervous system involvement in any of the patients. Subclinical muscle involvement and necrotizing myositis with pain, swelling and tenderness or only myalgia have rarely been reported in BD[25,26]. In addition to these, myopathy and neuropathy cases related to agents used in the treatment of BD such as colchicine and cyclosporine A have been reported[27,28]. In our study, colchicine was used alone or as a combination by 17 patients, as was cyclosporine A by 7 pa-

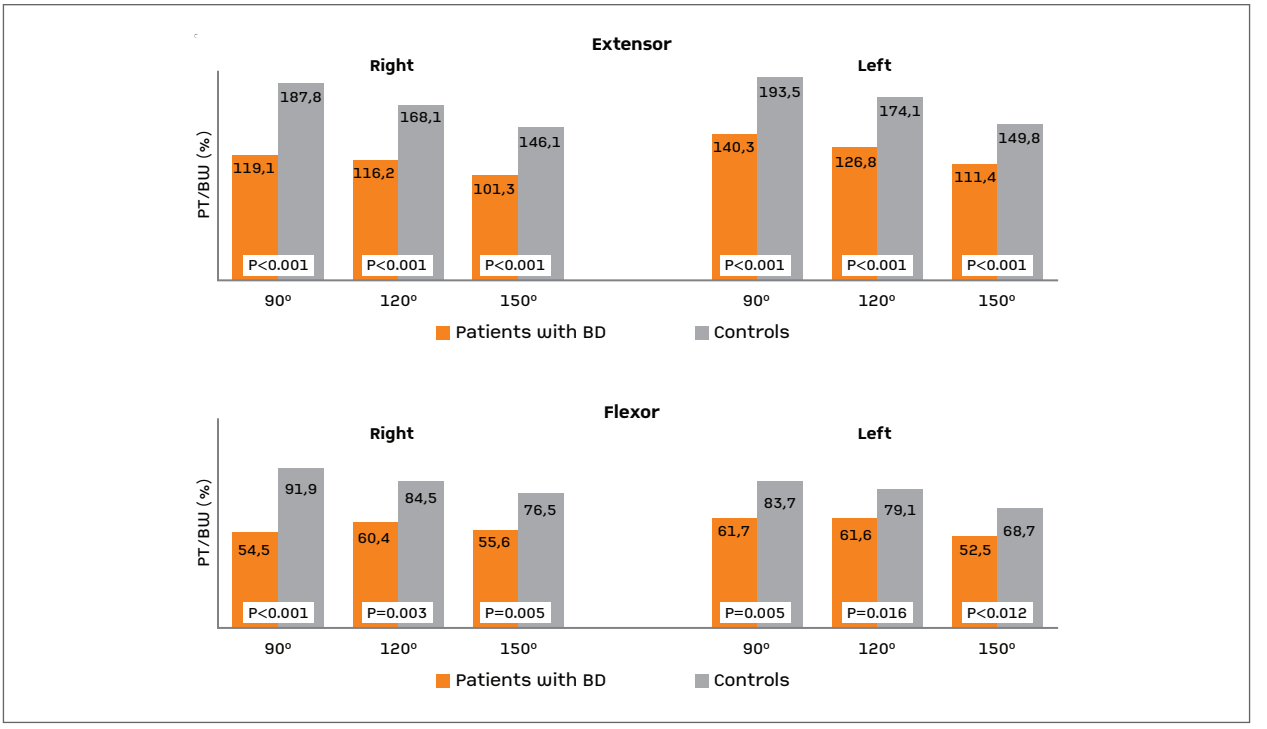

FIGURE 3. Peak torque/body weight ratios (%) of flexor and extensor knee isokinetic muscle strength in patients with BD and healthy subjects (controls)

tients. All of this information showed that, muscle strength and functional status could be affected in BD patients even without causing disability.

BD is characterized by exacerbations and remissions. The duration of attacks ranges from a few days to a few weeks and sequelae can be found after attacks[25]. These attacks could lead to immobilization of patients, as well as result in loss of muscle strength and functional disability. In a study which was based on a comparison of the functional disabilities between BD and rheumatoid arthritis, Behcet's patients were found to have higher functional disability and fatigue than RA patients. In that study, the functional disability scores of RA patients were similar to Behçet's patients without arthritis[29]. In RA patients it has been shown that, knee isokinetic muscle strengths are correlated with Health Assessment Questionnaire (HAQ) scores that are used for the measurement of functional disabilities. In 36 RA patients, it was found that knee isokinetic muscle strength was correlated with HAQ, which is a patient reported outcome measure for functional disability in RA[17]. Current tools for assessing BD do not include patient-reported outcomes for assessment of functional disability such as HAQ[29]. In one study, it was reported that knee extensor strength reduced by 25% in patients without a clinically defined affected knee in RA and with an affected knee joint, while knee-extensor strength decreased up to 78% compared to a control group[10]. In another study, muscle strength of 67 RA patients with low and moderate disease activity was evaluated with isokinetic and isometric methods. Knee involvement was detected in just 16 of the patients. Comparison with healthy controls revealed a significant decrease in both isometric and isokinetic muscle strengths and endurance in RA patients[30]. Systemic lupus erythematosus (SLE) is also another multisystemic rheumatologic disease and usually does not cause destructive arthritis as BD does. In a study involving 43 SLE patients where, quadriceps muscle strength and exercise capacity with a bicycle ergo meter were compared with sedentary controls, it was found that both parameters were nearly 21% lower compared to those measured for the controls[31]. In another study, which investigated the aerobic capacity of Behcet's patients, it was shown that exercise capacity with bicycle ergo meters was less than that of the controls[32].

In a recent study, possible involvement of the quadriceps muscle was shown in BD patients. Quadriceps and

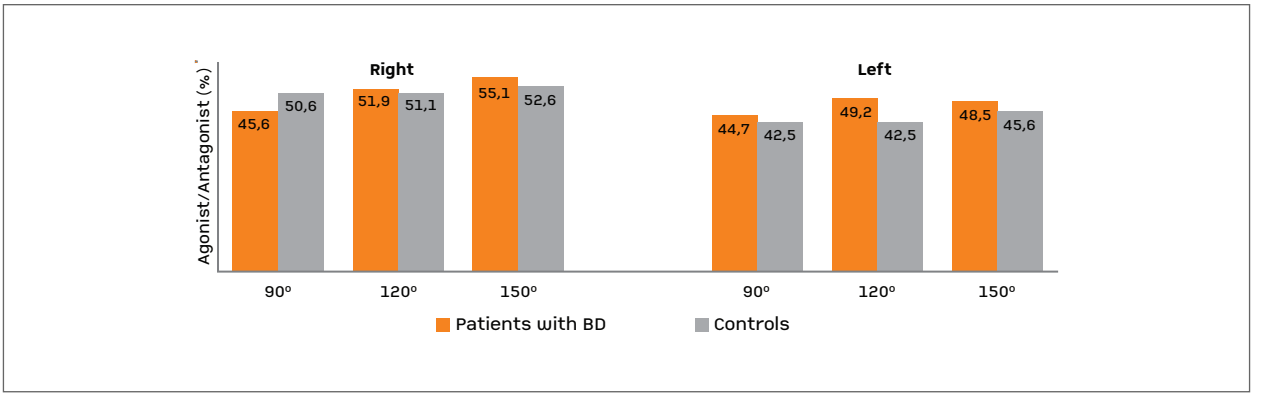

FIGURE 4. Agonist/antagonist (flexor/extensor) ratios (%) for right and left knee at 90°, 120° and 150°/sec velocities in patients with BD and healty subjects (controls)

Achilles tendon thicknesses were measured with ultrasonography (US) in BD patients, with the results demonstrating that quadriceps tendon thickness was significantly higher compared to the controls. An important point of that study is that tendon thickness was also higher in patients without arthritis[33]. This could be a sign of subclinical periarticular inflammation. In a similar study, hand and foot tendon thicknesses were measured in 33 BD patients with US, and in both regions tendon thickness was found to be significantly higher compared to controls. In the same study, weak hand grip strength was observed in BD patients, which was not significantly obvious in the controls[34].

In clinical practice for assessment of joints; joint tenderness and swelling as well as, erythrocyte sedimentation rate (ESR) and C-reactive protein (CRP) are the clinical and laboratory parameters more commonly used than other parameters available. In diseases associated with arthritis, it is not practical to use generic or disease specific patient reported outcome measures such as HAQ for the evaluation of functional disability. Manual muscle testing (MMT) is the most commonly used non-quantitative test for clinical assessment of muscle strength. The success of MMT is dependent on personal experience and abilities[35], since it is very difficult to detect minor alterations in muscle strength with MMT. Supporting this general claim, in a recent study, a comparison of the isokinetic torque with the MMT values for the knee flexors and extensors showed that the isokinetic measurement was more sensitive than MMT, even in cases of severe weakness[36]. Therefore, in diseases with subclinical muscle weakness, it is better to use an isokinetic dynamometer for a more precise evaluation.

In our study, mild and moderate angular velocities were used for isokinetic muscle strength testing. Since the purpose of this study was to evaluate muscle strength, high angular velocities, which are mainly used for sports training were not preferred[14,37].

To summarize our findings; in BD patients without active inflammatory knee arthritis, both knee flexor and extensor muscle strength were reduced. Muscle weakness in BD could be related to arthropathy; whereas factors such as uveitis attacks and neuropathy can also cause muscle weakness due to functional impairment. Because there was a relationship between muscle strength loss in the anterior and posterior musculature, muscle strengthening should be not only in the extensor musculature but global. Since there has not been any research related to isokinetic knee muscle strength in Behcet's patients so far, our results may lead to speculations and therefore should be supported with new studies and with long-term follow-up. Furthermore, we would like to point out remind that the limited sample of patients, which is a drawback of our study, might be insufficient to make a definite conclusion.

In conclusion, isokinetic knee flexor and extensor muscle strength could be decreased in patients with BD. In clinical evaluation, regular muscle strength measurement could provide useful data related to functional impairment of Behcet's patients. Our first and preliminary findings pertaining to decreased bilateral knee extensor and flexor isokinetic muscle strength of BD patients should be complemented with future clinical studies.

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