

Clinical management of an adult with erythema infectiosum: a retrospective case report

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Objective: *To review the epidemiology, etiology, diagnosis and typical management of erythema infectiosum and to illustrate the clinical management of an adult with erythema infectiosum.*

Clinical features: *A 38-year-old male complaining of severe global pain, swelling, weakness and stiffness in his shoulders, elbows, knees, and fingers of seven weeks duration.*

Intervention and outcome: *The patient was treated with a combination of 1) pharmacological treatment of naprosyn, prednisone, methotrexate, hydroquinone and sulfasalazine, 2) conservative treatment consisting of spinal manipulation, peripheral joint mobilization, acupuncture and low-tech Qi Gong and Tai Chi exercises, and 3) an active physiotherapy program consisting of strengthening exercises, and stationary bike. The patient reported marked improvement in pain, mobility, strength, and function with the addition of conservative physical treatment.*

Objectif : *Examiner l'épidémiologie, l'étiologie, le diagnostic et la gestion typique de l'érythème infectieux, et illustrer la gestion clinique d'un adulte présentant un érythème infectieux.*

Caractéristiques cliniques : *Un homme âgé de 38 ans, se plaignant d'une douleur intense, de tuméfaction, d'une faiblesse et d'une raideur intense dans les épaules, les coudes, les genoux et les doigts depuis sept semaines.*

Intervention et résultats : *Le patient a été traité avec l'association suivante : 1) traitement pharmacologique aux naprosyne, prednisone, méthotrexate, hydroquinone et sulfasalazine, 2) traitement conservateur consistant en une manipulation vertébrale, une mobilisation articulaire périphérique, en de l'acupuncture et des exercices de Qi Gong et Tai Chi à faible technologie, et 3) un programme de physiothérapie active comprenant la pratique d'exercices de renforcement et de vélo stationnaire. Avec l'ajout d'un traitement physique conservateur, le patient a rapporté une nette amélioration de la douleur, de sa mobilité, de sa force et de sa condition.*

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The involved patient provided consent for case publication.

Summary: Erythema infectiosum is associated with a wide spectrum of clinical manifestations, where arthropathy is the most common clinical manifestation in adults. Erythema infectiosum should be suspected as a potential differential diagnosis when a patient presents with red or purplish skin rashes, especially when accompanied by fever and joint pain. Conservative management could be considered as an adjunctive therapy option for this condition. However, further validation and research is warranted.

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KEY WORDS: erythema infectiosum, Parvovirus B19, arthropathy, chiropractic, physiotherapy

Introduction

In healthy, immunocompetent individuals, parvovirus B19 (B19V) is the cause of Erythema infections (EI), also called “fifth disease” or “slapped cheek” disease.¹ EI is referred to as fifth disease because it was fifth of the common rash-associated diseases of childhood to be identified, which includes measles, scarlet fever, rubella, and varicella.¹ Fifth disease is also most common in children ages five to fifteen.¹ EI commonly affects children but can also continue at lower rates throughout adulthood.² EI symptoms are characterized by low-grade fever, malaise, a red “slapped cheek” facial rash, and later by the spread of a lacy or reticular maculopapular rash involving the trunk and limbs.² Arthropathy is the most common clinical manifestation in adults with EI and is usually of a brief duration, although some individuals do experience prolonged symptoms that last weeks to years.²

EI in adults is rare and poorly described in the literature.³ We report the case of a 38-year-old male presenting with severe global joint pain, swelling, stiffness and weakness of seven weeks duration due to EI. EI does not typically require treatment, but some patients with arthropathy may require symptomatic management such as anti-inflammatory medication.⁴

To our knowledge, there is no published literature regarding conservative care for arthropathy in adults with EI. In our case study, the patient elected to access con-

Résumé : L'érythème infectieux s'accompagne d'un large éventail de manifestations cliniques, l'arthropathie étant la plus courante chez l'adulte. L'érythème infectieux doit être considéré comme un diagnostic différentiel potentiel lorsqu'un patient présente des éruptions cutanées rouges ou violacées, surtout s'il est accompagné de fièvre et de douleurs articulaires. Un traitement conservateur pourrait être envisagé comme une option thérapeutique complémentaire pour cette affection. Toutefois, une validation et des recherches poussées s'imposent.

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MOTS CLÉS : érythème infectieux, Parvovirus B19, arthropathie, chiropratique, physiothérapie

servative care for his condition and received a variety of interventions consisting of chiropractic spinal and peripheral joint manipulation and mobilization, acupuncture, and range of motion and strengthening exercises. The conservative interventions were well tolerated, and the patient considered it to be a useful adjunct to the usual and customary pharmacological treatment.

The purpose of this case report is to review the etiology, epidemiology, clinical manifestations and typical medical management of this condition. It is important for primary healthcare providers to be aware of this condition as a potential differential diagnosis and should be suspected in individuals who present with maculopapular skin lesions, especially if accompanied by fever and arthropathy.

Case presentation

A 38-year-old male airport authority service worker presented with severe global pain, swelling, weakness and stiffness of seven weeks duration. He had been previously diagnosed with EI by an infectious disease specialist.

The patient had previously been tested for a wide variety of infectious diseases including syphilis, HIV, and Lyme disease, before it was concluded that he was suffering from severe reactive arthritis induced by Parvovirus B19. The patient's daughter, who had recently recovered from the illness, was suspected to have passed the infection to her father. He tested positive for a resolved



Figure 1.
Typical “Slapped Cheek” rash associated with Erythema Infectiosum.²⁶

Parvovirus B19 infection. Initial rheumatology investigations revealed elevated ESR (73mm/hr) and CRP (5.4mg/dL) levels. Low hemoglobin level was also noted.

Prior to presenting to our office, the patient had reported having the typical “slapped cheek rash” (Figure 1). A course of prednisone (5mg daily prescribed by a rheumatologist) had begun three weeks prior to initial presentation at our office. The patient reported that the prednisone had improved his ability to move noting a reduction from 23 to twenty hours per day spent in bed. He described the most severe stiffness in his shoulders, elbows, knees, and fingers with little swelling in his knees and severe swelling of all fingers.

Initially the patient self-medicated with Advil for two weeks. Subsequently a two-week prescription of Naprosyn (500mg bid) was attempted without any improvement. Prednisone (5mg daily) was prescribed for seven weeks then concurrent with a three-drug cocktail of methotrexate (20 mg weekly), hydroquinone (200 mg daily) and sulfasalazine (1000 mg bid). Folic acid supplementation was recommended to reduce side effects of methotrexate. The patient used non-prescription supplements as follows: 2000mg omega-3 fatty acids, 1000mg magnesium, high potency B-complex, 2000 mg Vitamin C, and 1000 IU vitamin D3. The combined prescription

drug regimen was stopped after six weeks and the patient resumed a short course of Naprosyn.

When the patient presented to our office, he was seven weeks into his post-viral reactive arthritis and was experiencing progressive musculoskeletal disability and impairment of daily function. He was spending twenty hours a day in bed despite the pharmacological regimen he was following. He had not been prescribed nor attempted any physical rehabilitation. Frustrated by the slow rate of his recovery the patient self-referred to our office.

The patient was measured at 178 cm in height, 82 kg in weight with an average build. On examination, he was normotensive with a resting pulse of 72 beats per minute. The patient ambulated very slowly and cautiously, becoming fatigued after walking 10 steps. He had difficulty lowering himself into a sitting position and did so deliberately and with determination, not demonstrating any signs of amplified pain behaviour. Passive range of motion (ROM) of all large joints was painfully limited with soft end feel. His fingers were markedly swollen and he was unable to make a fist with either hand. His grip strength was measured at five kilograms bilaterally with a hand-grip dynamometer.

Chiropractic care was initiated at a frequency of one visit per week for the first eight weeks. During this time

emphasis was placed on restoring mobility and encouraging active movement within the patient's tolerance. High velocity, low amplitude chiropractic spinal manipulation and mobilization primarily targeted to the thoracic spine as it was the area of greatest stiffness and tender joint dysfunction; peripheral joint mobilization attending to each phalangeal joint of all ten digits as well as shoulders, elbows, wrists, knees, and ankles; traditional Chinese acupuncture for reducing pain, swelling and inflammation including points Large Intestine-4 (LI-4), Liver-3 (LV3), Spleen-6 (Sp-6), Spleen-9 (SP-9), and Stomach-36 (ST-36) and low tech Qi Gong and Tai Chi exercises involving slow, mindful, continuous movements were employed in treatment. Subjectively, the patient reported feeling significant pain relief and improvement in mobility with each treatment. After the eighth week, the patient noted improved ROM and energy and of his own volition had discontinued pharmacological treatment.

At 20 weeks into the episode, 11 weeks after the commencement of chiropractic care, the patient was able to begin attending an active physiotherapy program three times a week. At this point he was spending 15 hours a day in bed, reduced from 20 hours at the beginning of care. He discontinued chiropractic care at that time as his insurance benefits had run out.

Upon the resumption of insurance benefits, he followed up at our office approximately seven months later having continued with physiotherapy during the intervening time. He had not yet returned to work and noted residual deficits in grip and the ability to form a fist, he was slow to warm up and slow to recover from exertion and fatigue. His grip strength was measured at 43.5 kg on the right and 45 kg on the left.

He resumed monthly chiropractic visits concurrent with twice a week physiotherapy consisting of active rehabilitation (ROM exercises, strengthening exercises, stationary bike). Spinal manipulation and joint mobilization were employed to improve mobility and function as indicated.

Over the next four months, the patient continued to demonstrate improvement in function. His grip strength was measured at 60 kg in each hand and complete finger flexion and fist closing was possible. There was residual limitation of horizontal abduction of both shoulders with pain at the plane of the anterior chest wall. The patient had gained 11 kg since initial consultation and had begun

a program to reduce some weight with aerobic exercise, swimming and portion control. The patient had discontinued all medication citing that he perceived they were not helpful in his ongoing recovery. Overall, the patient reported a subjective improvement of 75% better in pain relief, mobility, and strength.

During the final month, at almost one year from initial onset of symptoms, the patient reported a safe and sustainable return to work. The swelling in his large and small joints had resolved and that his endurance was back to normal. He continued to experience limitations in shoulder range of motion.

Discussion

Transmission of infection occurs via the respiratory route and can be transmitted from mother to foetus, through transfusion of blood products, bone marrow transplants, and solid-organ transplants.^{2,5}

EI is widespread and acquisition is often during childhood and continues at lower rates throughout adulthood, such that between 70% and 85% of adults show serologic evidence of past infection.² The peak incidence of parvovirus infection shows seasonal variation and occurs more commonly in winter and spring.²

Erythema infectiosum (EI) in adults is rare and poorly described in the literature.³ The condition is caused by Parvovirus B19 (B19V), the only known human pathogenic parvovirus.⁵ Erythema Infectiosum symptoms are characterized by low-grade fever, malaise, a red "slapped cheek" facial rash, and later by the spread of a maculopapular rash involving the trunk and limbs.² The rash normally disappears within one week, although intensity and remission of symptoms can occur for several months after emotional or physical stress or exposure to sunlight or heat.² To date, the largest retrospective analysis of 49 cases of adult onset EI was published by Bandera and colleagues in 2015, where they found that the maculopapular rash was a major diagnostic indicator of EI and was seen in over half the cases.³

Immunologically, detection of antibodies is the standard method of laboratory diagnosis of B19V infection, as they are the hallmark of the adaptive immune response to B19V infection.⁴ Immunoglobulin M (IgM) are first produced approximately 12 days post-infection and can usually last about three to six months following infection, soon followed by production of Immunoglobulin G (IgG)

that is assumed to be long-lasting.^{4,9} Immunoglobulin A (IgA) can also be detected in body fluids.⁴ Polymerase chain reaction (PCR) assays are also sometimes used to detect B19V DNA in the serum of infected individuals.⁹ B19V infections can also be accompanied by the induction of various auto antibodies such as anti-nuclear antibody (ANA), rheumatoid factor (RF), and anticardiolipin (ACL).¹⁰

Dobec and colleagues reported a case of a 37-year-old woman with persistent parvovirus B19 infection and arthralgia that was mistakenly treated for Lyme disease.¹¹ Medical treatment consisted of only Ponstan (mefenamic acid) 500 mg tablets that were taken as required to combat pain.¹¹ This particular case suggested that before making a final diagnosis of Lyme arthritis in an endemic region, other causative agents of arthritis such as B19V should be excluded to avoid unnecessary treatment or to add appropriate therapy in the case of co-infections.¹¹ Since parvovirus B19 is often associated with arthralgia and can mimic rheumatoid arthritis and autoimmune diseases, it should be included in the differential diagnosis of arthralgia.¹¹

In children with EI, the incidence of arthropathy is approximately 10% or less. While in adults, arthropathy is the most common clinical manifestation, occurring in 60% of female patients and 30% of male patients.⁶ Joint symptoms typically present as acute and moderately severe non-erosive polyarthritis involving the metacarpophalangeal joints, knees, wrists, and ankles.⁶ Although the joint symptoms are usually of brief duration, some do have prolonged symptoms that last weeks to years.²

There is currently no specific antiviral therapy to treat B19V infection.² The treatment approach of infection depends on host factors such as immune status, underlying conditions, and manifestations of infection.² Most cases of infection in immunocompetent hosts do not need treatment, while some patients with B19V-induced arthralgia may need symptomatic pharmacological treatment such as NSAIDs/anti-inflammatory drugs.² Few case studies have documented the management of arthropathies induced by B19V.

In 2005, Lowry and colleagues reported a case of a 48-year-old female physician with persistent B19V infection that was complicated by prolonged fatigue and arthritis associated with cartilaginous and ligamentous damage in both wrists.⁶ Nineteen months after presenta-

tion, intravenous immunoglobulin therapy resulted in clearance of parvovirus B19 viremia and a significant improvement in the symptoms of fatigue and arthritis.⁶ In 2008, Ogawa and colleagues reported a case of an immune-competent Japanese adult woman with persistent B19V who developed chronic severe B19V associated arthritis without PRCA or chronic anemia.⁵ The patient was initially treated with NSAIDs but the NSAID treatment was unable to control her arthralgia.⁵ She then received high-dose intravenous immunoglobulin (IVIg) at a dosage of 0.4g/kg per day for five successive days and experienced remission from the disease two weeks following the IVIg treatment.⁵

Based on previous case studies and current literature, the emphasis of medical management on B19V-induced arthropathy is on mitigation of inflammatory process through pharmacological intervention such as anti-inflammatory drugs.^{2,4,5,6,11} To our knowledge, there are currently no case reports or literature regarding conservative management of arthralgia in adults with EI. In our case study, the patient elected to try conservative care for his condition and received a variety of interventions consisting of chiropractic spinal and peripheral joint manipulation and mobilization, acupuncture, and range of motion and strengthening exercises.

Spinal manipulation is a commonly used intervention for the management of musculoskeletal conditions.¹² In 2009, Walser and colleagues conducted a systematic review and meta-analysis on the effectiveness of thoracic spine manipulation and found that there was significant evidence to support the use of thoracic spine manipulation for non-specific neck and thoracic pain.¹² In our case study, high velocity, low amplitude manipulation was used and directed to the thoracic spine, which had the greatest joint dysfunction and restriction.

Joint mobilizations are also commonly used in the treatment of musculoskeletal conditions to decrease pain and restore joint arthrokinematics, which often involve passively moving the joint or rhythmically oscillating a joint through an accessory range of motion.¹³ The treatment effects of joint mobilizations are thought to increase the extensibility of non-contractile tissues surrounding a joint and activate the neurophysiological mechanisms that alter the transmission of nociceptive afferent impulses¹³ likely via enhancement of descending pain mechanisms¹⁴. In 2016, Courtney and colleagues found that conditioned

pain modulation in individuals with knee osteoarthritis was significantly enhanced by joint mobilizations, which was demonstrated by a global decrease in deep tissue pressure sensitivity.¹⁴

Acupuncture is considered a simple, cost effective and convenient treatment intervention and could “serve as a valuable alternative treatment for many conditions in which modern conventional treatments are unsuccessful”¹⁵. The analgesic and anti-inflammatory efficacy of acupuncture is well documented within controlled clinical trials.¹⁵⁻¹⁹ Studies have shown that acupuncture may exert its anti-inflammatory and analgesic effects via elevating anti-inflammatory cytokines level and reducing pro-inflammatory cytokine level and regulating Th 1/Th 2 balance¹⁸ or via the release of endogenous opiates, which desensitize peripheral nociceptors and reduce proinflammatory cytokines¹⁹. In our study, traditional Chinese acupuncture was used at acupuncture points Large Intestine-4 (LI-4), Liver-3 (LV3), Spleen-6 (Sp-6), Spleen-9 (SP-9), and Stomach-36 (ST-36) to reduce pain, swelling and inflammation.

Qigong and Tai Chi are traditional Chinese wellness practices that focus on “three regulations” including body focus (posture and movement), breath focus, and mind focus (meditative, mindful components).²⁰ Both Qigong and Tai Chi sessions incorporate a wide range of physical movements and a series of orchestrated practices, including slow, meditative, flowing, dance-like motions.²⁰ According to a comprehensive literature review by Jahnke and colleagues²⁰ and a systematic review by Li and colleagues²¹, Qigong and Tai Chi appears to be safe and has positive effects on health related quality of life in patients with various chronic conditions, bone health, cardiopulmonary fitness, and factors related to falls prevention^{20,21}. In our current case report, traditional Tai Chi and Qigong warm up movements were prescribed to encourage general motion at the shoulders, elbows, knees, and fingers while some exercises were extracted specifically from the Yang style Tai Chi form and isolated to encourage shoulder movement.

To our knowledge, there is no literature regarding rehabilitation exercises for arthropathies in individuals with EI. However, there is research regarding physiotherapy exercise programs for arthropathies induced by other viral infections. Previous research has found that physiotherapy treatment was effective in decreasing pain and

edema and improving muscle strength, range of motion, and functional capacity in patients with post chikungunya arthralgia.^{22,23} Rehabilitation exercise and strength training has also been shown to improve joint range of motion, decrease pain perception and increase muscle strength in patients with osteoarthritis²⁴ and rheumatoid arthritis²⁵. However, the optimal content of exercise therapy programs remains inconsistent.²⁴ Physiotherapy consisting of active rehabilitation (ROM exercises, strengthening exercises, stationary bike) was added to reduce pain, increase strength and endurance while in conjunction with chiropractic care in order to improve and maintain mobility and function.

Although EI is primarily a pediatric condition, it can also occur in adults and primary healthcare providers should be aware of this condition, especially when adults present with acute polyarthritis.

Summary

Erythema Infectiosum is a viral illness that is associated with a wide spectrum of clinical manifestations, where arthropathy is the most common clinical manifestation in adults. EI should be suspected as a potential differential diagnosis when a patient presents with red or purplish skin rashes, especially when accompanied by fever and joint pain. Specific antiviral therapy is not available to treat EI and the current treatment approach for immunocompetent patients with arthropathy associated with EI is to decrease symptoms through pharmacological treatment. The ideal treatment intervention should aim to minimize symptoms and recurrence while limiting associated risks. Conservative management could be considered as an adjunctive therapy option for providing symptomatic relief from EI induced arthropathy.

In our case report, the patient elected to try conservative treatment and subjectively reported that the conservative treatment provided symptomatic relief and considered it to be a useful adjunct to the usual and customary pharmacological treatment.

We acknowledge that the current report consists of only one individual and thus is not representative of the entire population of individuals with EI induced arthropathy. Thus, future research is needed to explore the value of conservative treatment for adults presenting with EI.

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References

1. Young NS, Brown KE. Parvovirus B19. *New Engl J Med*. 2004;350(6):586-597.
2. Rogo LD, Mokhtari-Azad T, Kabir MH, Rezaei F. Human parvovirus B19: a review. *Acta Virol*. 2014;58(3):199-213.
3. Bandera AR, Arenal MM, Vorlicka K, Bravo-Burguilllos ER, Vega DM, Díaz-Arcaya CV. Acute parvovirus B19 infection in adults: a retrospective study of 49 cases. *Actas Dermo-Sifiliográficas (Engl Ed)*. 2015;106(1):44-50.
4. Heegaard ED, Brown KE. Human parvovirus B19. *Clin Microbiol Rev*. 2002;15(3): 485-505.
5. Ogawa E, Otaguro S, Murata M, Kainuma M, Sawayama Y, Furusyo N, Hayashi J. Intravenous immunoglobulin therapy for severe arthritis associated with human parvovirus B19 infection. *J Infection Chemother*. 2008;14(5):377-382.
6. Lowry SM, Brent LH, Menaldino S, Kerr JR. A case of persistent parvovirus B19 infection with bilateral cartilaginous and ligamentous damage to the wrists. *Clin Infect Dis*. 2005;41(4): 42-44.
7. Aravindh R, Saikia UN, Mishra B, Kumari V, Sarkar S, Sharma M, Ratho RK, Joshi K. Persistence of human parvovirus B19 in tissues from adult individuals: a comparison with serostatus and its clinical utility. *Arch Virol*. 2014;159(9):2371-2376.
8. Moore TL. Parvovirus-associated arthritis. *Curr Opin Rheumatol*. 2000;12(4):289-294.
9. Pedranti MS, Barbero P, Wolff C, Ghietto LM, Zapata M, Adamo MP. Infection and immunity for human parvovirus B19 in patients with febrile exanthema. *Epidemiol Infection*. 2012;140(3): 454-461.
10. Parra D, Mekki Y, Durieu I, Broussolle C, Sève P. Clinical and biological manifestations in primary parvovirus B19 infection in immunocompetent adult: a retrospective study of 26 cases. *Revue Medecine Interne*. 2014;35(5): 289-296.
11. Dobec M, Kaeppli F, Cassinotti P, Satz N. Persistent parvovirus B19 infection and arthralgia in a patient mistakenly treated for Lyme disease. *J Clin Virol*. 2008;43(2): 226-229.
12. Walser RF, Meserve BB, Boucher TR. The effectiveness of thoracic spine manipulation for the management of musculoskeletal conditions: a systematic review and meta-analysis of randomized clinical trials. *J Man Manip Ther*. 2009;17(4): 237-246.
13. Gorgos KS, Wasylyk NT, Van Lunen BL, Hoch MC. Inter-clinician and intra-clinician reliability of force application during joint mobilization: a systematic review. *Man Ther*. 2014; 19(2): 90-96.
14. Courtney CA, Steffen AD, Fernández-De-Las-Peñas C, Kim J, Chmell SJ. Joint mobilization enhances mechanisms of conditioned pain modulation in individuals with osteoarthritis of the knee. *J Ortho Sports Phys Ther*. 2016;46(3): 168-176.
15. World Health Organization. Acupuncture: review and analysis of reports on controlled clinical trials. World Health Organization; 2002.
16. Feng JJ, Wang K, Chen TY, Ge W, Zhou YR, Xu JJ, Zhou J. Research on acupuncture in regulating the inflammatory reaction in anti-ischemia-reperfusion injury. *Zhen ci yan jiu Acupuncture Research* 2017;42(6):552-556.
17. Linde K, Weidenhammer W, Streng A, Hoppe A, Melchart D. Acupuncture for osteoarthritic pain: an observational study in routine care. *Rheumatology*. 2005;45(2):222-227.
18. Hong SH, Ding SS, Zhang K, Xu Y, Zhao X, Xuan LH, Guo Y. Development of researches on cytokine mechanisms in analgesia and anti-inflammation in acupuncture therapy for rheumatoid arthritis. *Zhen ci yan jiu Acupuncture Research* 2016;41(5):469-473.
19. Zhang R, Lao L, Ren K, Berman BM. Mechanisms of acupuncture-electroacupuncture on persistent pain. *Anesthesiol*. 2014;120(2): 482-503.
20. Jahnke R, Larkey L, Rogers C, Etnier J, Lin F. A comprehensive review of health benefits of qigong and tai chi. *Am J Health Prom*. 2010;24(6): e1-25.
21. Li G, Yuan H, Zhang W. Effects of Tai Chi on health related quality of life in patients with chronic conditions: a systematic review of randomized controlled trials. *Compl Ther Med*. 2014;22(4):743-755.
22. Rahman MH, Islam N, Haque M, Hossain M, Kakuli SA, Rashid NR. Effectiveness of physiotherapy treatment for post chikungunya arthralgia. *Edorium J Publ Health*. 2017; 4: 69-75.
23. Oliveira AD, Silva JG. Effect of a physiotherapy program in patient with persistent polyarthralgia after chikungunya fever. Case report. *Revista Dor*. 2017;18(4): 370-373.
24. Nguyen C, Lefevre-Colau MM, Poiraudou S, Rannou F. Rehabilitation (exercise and strength training) and osteoarthritis: a critical narrative review. *Ann Phys Rehabil Med*. 2016; 59(3): 190-195.
25. Verhoeven F, Tordi N, Prati C, Demougeot C, Mouglin F, Wendling D. Physical activity in patients with rheumatoid arthritis. *Joint Bone Spine*. 2016;83(3): 265-270.
26. https://commons.m.wikimedia.org/wiki/File:Slapped_cheek.png