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LEG LENGTH DISCREPANCY: ANATOMICAL CHANGES, LOAD DISTRIBUTION AND STRESS RESPONSE

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1. INTRODUCTION

Leg Length Discrepancy (LLD) also known as anisomelia is defined as a case of asymmetry in an unpaired lower limb. This condition often occurs in three different categories, which are true LLD, functional LLD, or environmental LLD [1]. The true LLD known as structural discrepancy results from the actual anatomic contraction of one or more bony structures of the lower limb. It could happen, for instance, when there are growth plate injuries or fractures, during childhood or youth, that alter bone growth. Functional discrepancies are caused by joint contraction or foot positional deformity and result in the appereant inequality of the lower limb leg without bone deficiency. Pelvic obliquity is one of the examples on functional discrepancy. The last category the discrepancy derived from environmental factors, such as exercising with shoes that initiate or mimic the LLD [2].

LLD is a typical issue found in 40% [3] to 70% [4] of the population. It appear to be the third most typical cause of running injuries, and occur in 60% to 90% of the population. LLD in athletes could disturb the routine of their training. The presence of LLD may indicate a musculoskeletal dysfunction and has been implicated as an aetiological factor in Low Back Pain (LBP), and in hip, knee, ankle, and foot pain as well as stress fracture [5]–[7]. According to the previously mentioned statistics, a healthy people with LLD could later develop a knee, hip or lumbar osteoarthritis (OA) at

the shorter limb [8]. This condition results from the degenerative joint disease on the shorter limb caused by thinning of the articular cartilage. Thus, pelvic tilt appears because of the unequal stresses in the hip and the knee joints during the standing posture.By the magnitude of discrepancy, LLD is classified as mild (LLD $<$ 3cm), moderate (3cm $\leq$ LLD $<$ 6cm), and severe (LLD $\geq$ 6 cm) [9]–[12]. According to this classification, the recommended treatment for mild LLD just consist in shoes with insole or outsole, whereas for moderate LLD small surgeries that can enhance the bone growth or slow down the growth rate of the bone are required. For severe LLD, it is advised to wear an artificial leg on the shorter side [13] Much of the research has focused on the mild LLD, because of the effects derived from this condition.

Some authors [14]–[18] revealed that 20 to 30mm of discrepancy could cause musculoskeletal disorders such as LBP. Regarding gait alteration, some authors [19]–[21]found that 20-30 mm of unequal length limb would lead to scoliosis and increased ground reaction force. Not much of the available literature has discussed issues related to the effects of the moderate and severe classes of LLD, because it is more of the treatments and surgery methods [22], [23]. Untill now, most of the research focused on the clinically significant length discrepancies. Less has been explored on the biomechanical effects, especially those related to alteration in kinetic parameters. The alteration of kinetics could lead to the occurence of bone fractures, because of the repetitive and extreme loading transmitted with the unequal leg length. Hence, this review was written to assess the stress response that is correlated with LLD. The bone fracture risk could provide an alert to a patient who has been diagnosed with LLD. As LLD produces an unpaired limb length, the structure of the body is shifted, and thus, an unequal loading is transferred on each limb. Then, one of the limbs has to sustain excessive load. At last, that limb will experience stress beyond its limit, and the fracture will occur.