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SOFT TISSUE BALANCING IN TOTAL HIP ARTHROPLASTY

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ABSTRACT

We present our experience with the soft tissue balancing in total hip arthroplasty. Detailed indications, planning and surgical technique are presented. The described procedures are performed on 278 hips for a period of 6 years (2008-2014). We conclude that the outcome of a THA can be improved by balancing the stability, ROM, muscle strength and limb length equality.

Key words : THA, soft tissue balancing, selective muscle, release femoral offset, limb length equality

The total hip arthroplasty (THA) is one of the most frequent and successful reconstructive procedures. A lot of authors report more than 90% satisfactory results in 10 years. The bad clinical results are most frequently connected with comorbidity, component malposition, aseptic loosening or infection. However, there is a subgroup of patients having soft tissue related problems, that are difficult detect, both clinically and radiographically. Those can be abductor dysfunction, limb length discrepancy, or soft tissue imbalance [1, 2, 3]. The most important factor for the latter is the restoration of the femoral offset. It affects the strength, the range of movement (ROM) and the stability of the joint [2, 13]. The achievement of an equilibrium between those factors is of paramount importance. It can be gained by the release of contracted muscles around the joint. The rehabilitation is hastened, the ROM is increased and the inguinal and knee pain is diminished [8]. The functional limb length discrepancy is also reduced [4, 5]. Clinical experience and the literature data confirm that increased offset and soft tissue balance lead to increased stability and longevity of the THA. [2, 3, 4, 6, 7, 8, 9, 10]. F. Pouwells and J. Charnley are the first to discuss the necessity of an adequate soft tissue tension around the THA [11]. The term "soft tissue hip balance" is later defined by Longjohn D and Dorr LD in 1998 [2].

MATERIAL AND METHOD

We considered patients with hip contractures greater than 20 ° in flexion, abduction and external rotation to be candidates for soft tissue balancing in the course of their THA. If there was a substantial shortening of the femur as a result of head collapse or proximal migration, soft tissue releases were also planned in advance [2]. If during the course of the procedure full extension, adequate abduction (beyond 20°), or flexion of the knee above 90-100° were not achieved, this was also considered as an indication for soft tissue balancing [2].

For the period 2008-2014 soft tissue balancing was performed on 278 hips. Four basic methods were used, including removal of the contracted joint capsule and periarticular adhesions, excision of the osteophytes, restoring the limb length and selection of a component with a proper offset. These are in fact obligatory steps in every THA. Additional soft tissue releases of m.ilipsoas, fasciae latae, or m.rectus femoris were necessary in only 32 hips. Due to the fact that release of some kind was done in the course of a standard THA it is quite difficult to quantify the results of these procedures.

Preoperative analysis

The preoperative planning includes assessment of the gait, the limb length discrepancy and the contractures around the hip. The ROM is estimated both pre- and post operatively. The stencil planning is obligatory, in order to restore the limb length, the anatomical center of rotation and offset, as well as the level of neck osteotomy and the proper design, size and placement of the prosthesis. The most important radiographic landmarks are the position of the lesser trochanter or the center of rotation in relation to the ischiadic line (figure 1).

Surgical technique

The surgical technique is based on the strategy for soft tissue balancing proposed by Longjohn and Dorr [2]. We also believe in the "Kaizen" philosophy that peruses considerable results through systematic, consecutive, small steps [12].

The first step in our surgical protocol consists of removal of the thickened joint capsule, the periarticular adhesions and osteophytes. We then compare the length of the limbs and the offset, before the dislocation of the joint and then again after the insertion of the trial implants. This is performed by sticking a needle in the spina iliaca superior anterior and a second one in the greater trochanter. The distance between them is measured in full extension (figure 2).

The offset can be determined by palpation of the distance between the greater trochanter the pelvis. In abduction and external rotation there must be at least a finger width. In full extension and external rotation the interval between the lesser trochanter and the pelvis must also be at least a finger width. In 90 ° flexion and internal rotation the anterior portion of the femoral neck must be a finger width away from the pelvis (figure 3). These measurements are not correct if there isn't a proper soft tissue balance and full ROM.

If the complete extension is not possible we palpate the iliopsoas tendon and if found tight it is elongated by sequential cutting (figure 4). It must not be completely released because this leads to postoperative weakness when climbing stairs or getting out of a car [2]. Other possible reason for incomplete extension is a contracted anterior capsule, in which case it must be excised.

If the abduction and external rotation is limited to 20 °, or there is a limitation of the adduction (a positive Ober test), we perform release of the m. tensor fasciae latae, distally from the m. gluteus medius aponeurosis (figure 5). If there is still limitation of the ROM, an implant with a proper offset must be selected. If the limb length is correct, but the greater trochanter is still close to the pelvis, we chouse to either increase the length or perform a distal throchanteric flip.

If despite the release of the m. tensor fasciae latae, the knee can not be flexed beyond 100°, a m. rectus femoris release is necessary (figure 6).

We performed additional tests for soft tissue balance. These include the Shuck test, the Dropkick test and direct comparison of the limb length by palpation.

In the event of highly dysplastic joints (Crowe III,VI), ankilosis, neuro-muscular diseases, revision THA, there is sometimes need for additional releases like adductor tenotomy, m. gluteus maximus desinsertion and m. sartorius tenotomy.

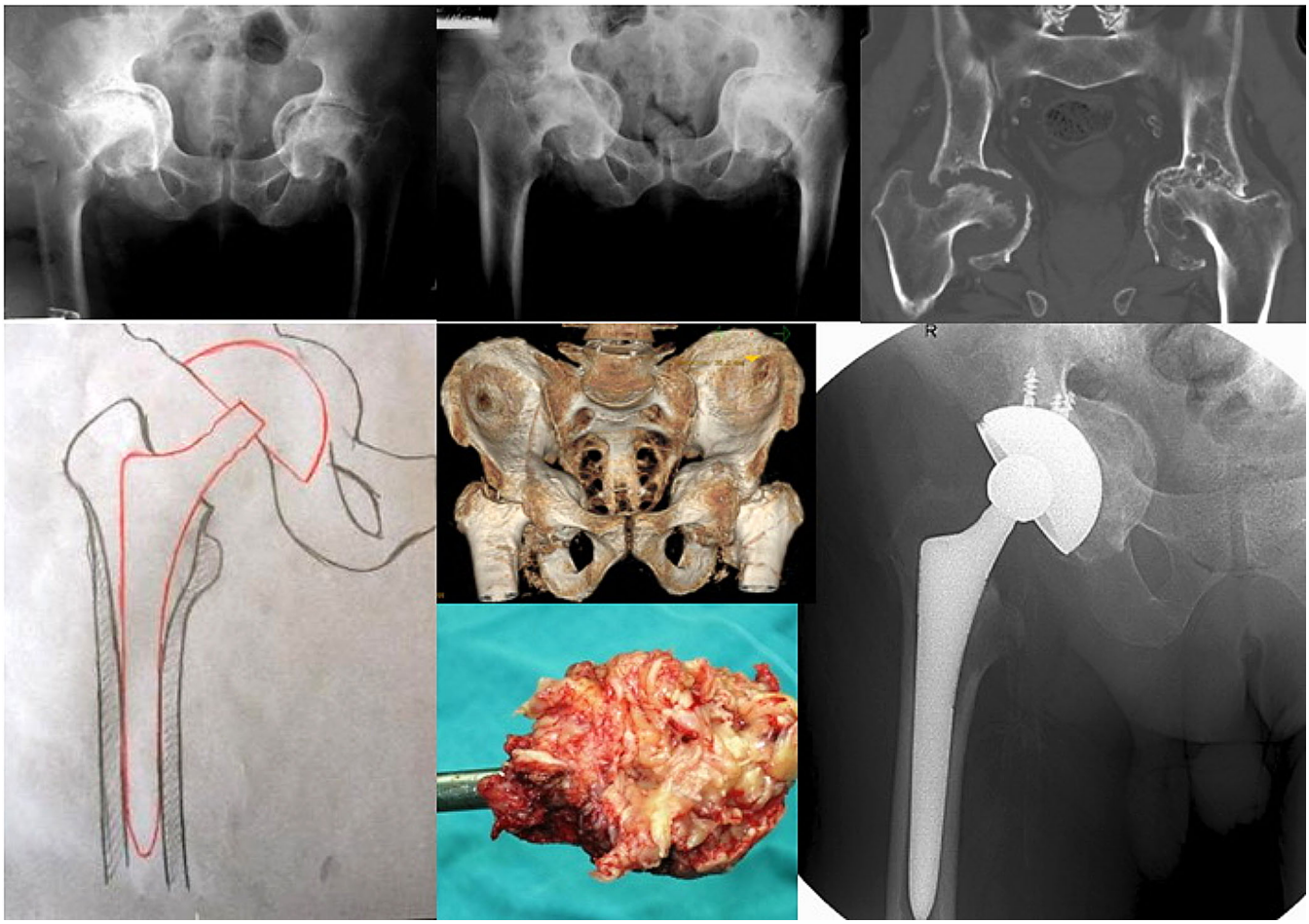


Fig. 1. preoperative planning

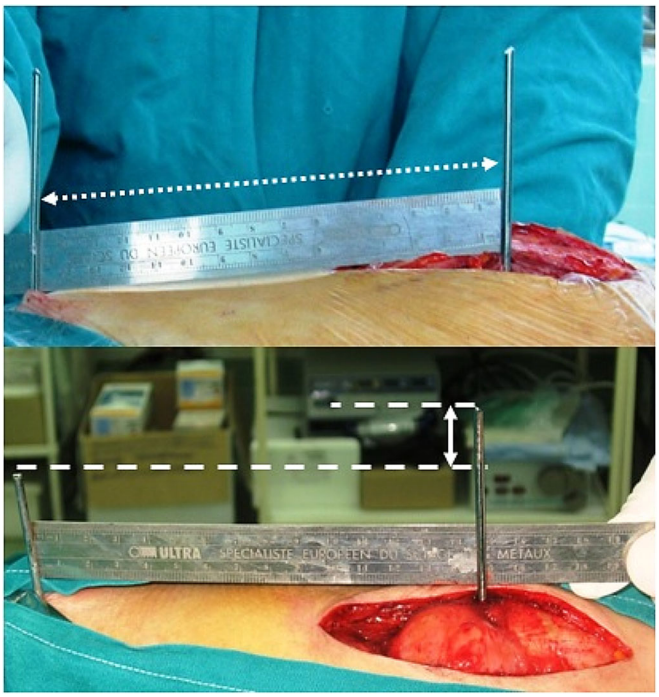
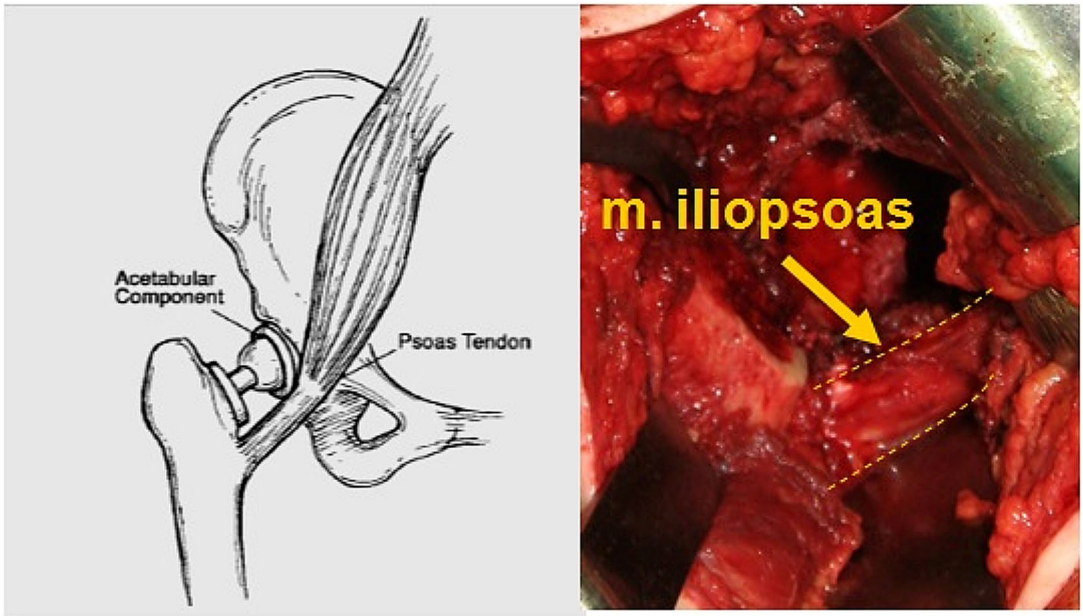


Fig. 2. offset and length measurement

Fig. 3. the one finger rule

Fig. 4. iliopsoas release



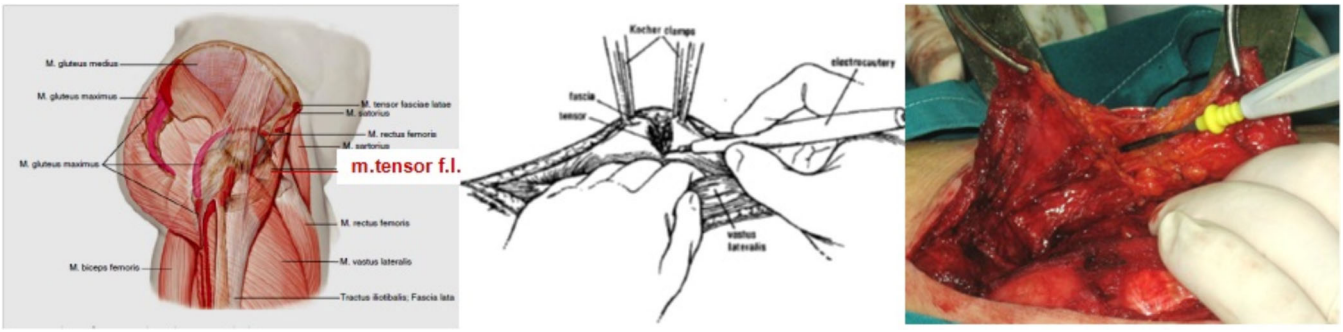


Fig. 5. tensor fasciae latae release

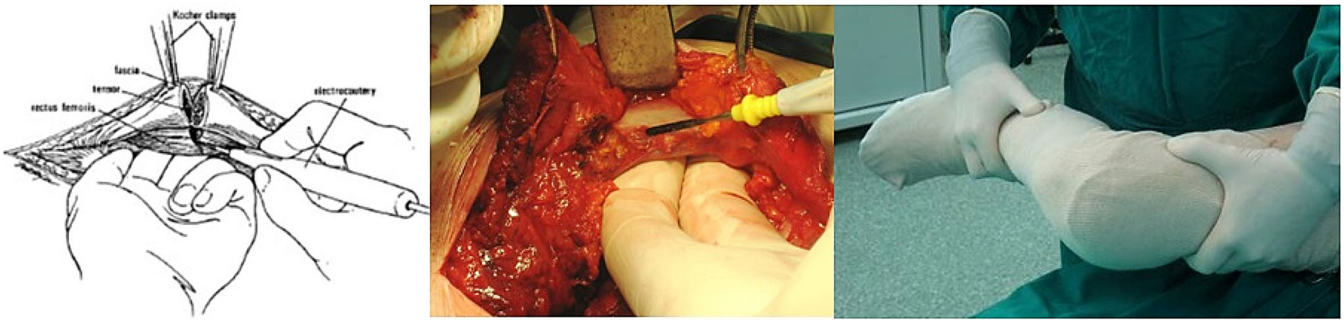


Fig. 6. rectus femoris release

DISCUSSION

The idea that the contracted hip structures must be released is not new, but there is paucity of literature data for the significance of the muscle function and balance for the THA [2, 3, 8, 14]. In the last years it becomes more and more clear that the soft tissue balance of the hip is as important as the design and the proper implantation of the THA. This includes release of the static and dynamic contractures and the achievement of proper femoral offset and limb length.

In the event of a painful THA the first cause is probably the aseptic loosening, but if the components are well placed and fixed, the pain can be result of abductor dysfunction or soft tissue imbalance. In the first case it is located around the trochanter. Pain in the lateral aspect of the knee can be caused by contracture of the iliotibial tract. Anterior knee pain is usually caused by a contracture of m. rectus femoris, and in the inguinal region, of the m.iliopsoas. Release of the m. tensor fasciae latae, the iliotibial tract and m.rectus femoris significantly lessens the postoperative knee pain. Each of these contractures can by itself decrease the ROM and function of the hip joint [2].

Important aspect of the soft tissue balancing is the determination of the femoral offset before and after the operation. Numerous authors reveal that insufficient offset increases the risk of impingement, laxity, instability and dislocation of the prosthesis [1, 3, 9, 10].

The bad abductor function leads to impaired gait, quick fatigue and need for crutches. On the contrary the adequate offset increases the abductor lever arm, decreasing the energy necessary for walking. This increases the abductor strength [3], stability [8], ROM [3] and decreases the frequency of aseptic loosening [9] The lessening of the joint reactive forces reduces the polyethylene wear, thus increasing the prosthesis longevity [3, 6, 7, 8]. The preoperative templating and the intraoperative direct measurements should avoid offset overcorrection.

CONCLUSION

The reduction of the postoperative pain and the improvement of the function after a THA can be achieved by balancing the stability, ROM, muscle strength and limb length equality. The stability is of course of foremost priority. The achievement of a soft tissue balanced hip joint demands detail planning, systematic operative approach and proper post operative rehabilitation. In conclusion we consider that the soft tissue balancing of the hip must be approached in the same fashion as the knee ligamentous balance.

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