

Balance Remains Impaired after Hip Arthroplasty

Subjects: Allergy

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Hip arthroplasty (HA) is the end-stage intervention for patients affected by hip osteoarthritis (OA). It is the most common joint replacement procedure and the number of patients undergoing prosthetic implantation is progressively growing due to the ageing population. The evidence suggested that balance is impaired immediately after surgery and, 4–12 months after surgery, it becomes better than preoperatively, although without reaching the level of healthy subjects. A strong level of evidence was found for hip resurfacing resulting in better balance restoration than total HA (THA), and for strength and ROM exercises after surgery positively influencing balance.

Keywords: balance ; hip ; arthroplasty ; proprioception

1. Introduction

Hip arthroplasty (HA) is the end-stage intervention for patients affected by hip osteoarthritis (OA). It is the most common joint replacement procedure and the number of patients undergoing prosthetic implantation is progressively growing due to the ageing population ^{[1][2]}. Even though HA shows excellent clinical results and has sometimes been referred to as “the operation of the century” ^[1], the risk of falls remains high, with the inherent detrimental consequences for the elderly and fragile patients ^[3]. Around one-third of the over 65 people living in the community are at risk of falling at least once a year, with consequent fractures or major injuries in 10% of falls ^[4]. Falls have been supposed to increase in the next years due to the ageing of the world population, and they are an important cause of death among the elderly ^[5]. Often, falls are associated with a loss of balance, which is a complex function regulated by the integration of the sensory inputs coming from the somatosensory, the visual, and the vestibular systems, as well as by the response capacity of muscles ^[6].

Since hip OA causes damage to the proprioceptors, the risk of loss of balance—and therefore of falling—is even higher in people affected by hip OA ^{[7][8]}. After HA, the patients' balance is impaired by different factors: the muscles are weaker, the lever arms are changed, the operated leg can be shorter than the other one and it bears less weight, there is a global reduction in range of movement, and the surgical capsular excision can cause additional damage to the proprioceptors ^{[9][10][11]}.

2. Current Insights

Since so many systems regulate balance, surgery—the main function of which is to restore the function of the target joint—is only partially able to completely restore balance when it is impaired as severely as it is by hip OA. Though HA does help restore balance, the extent to which it is effective in doing so varies in time. While balance is impaired immediately after surgery, more conflicting results have been reported for up to 3 months. Afterwards, the majority of the studies report that balance improves, and all the studies agree that at 4–12 months after surgery balance is better than at pre-op. However, despite this improvement, the majority of the retrieved studies state that the balance of HA patients is worse than that of healthy subjects. This finding is further strengthened by the recent work of John et al. ^[12], which found persisting asymmetries between the operated and the non-operated leg four to five years after THA. A persisting impairment of balance in patients who underwent HA might be explained by the fact that this type of surgery is not able to reverse the damage that OA causes to certain tissues (particularly the hip joint capsule and the soft tissues around it) which are rich in proprioceptors and therefore highly correlated with balance.

Balance is a topic of particular interest to researchers because it is highly correlated with the risk of falling, and falls, especially in the elderly, represent a serious risk of injury (25–60%, as reported by Kannus et al. ^[13]). Moreover, the number of falls is expected to increase over the next years, because the average age of the population keeps increasing. In patients affected by hip OA, the risk of falls is estimated to be 50%. After HA, the risk remains high, with 36% of people falling at least once in the first year after surgery ^{[14][15]}. Ikutomo et al. ^[15] analyzed patients living independently who had undergone HA and found that the most common causes of falls were tripping and loss of balance. In addition, it was found that these patients had a lower physical function and worse gait characteristics than people who never fell. In another

study, the same authors documented that the presence of gait abnormalities is a useful screening tool to predict falls in a patient affected by hip OA who had undergone THA [16]. Since the reduction of balance in the early period following HA likely leads to falls, an improvement in patient management in this period should be pursued to mitigate the risk of falling [17].

Pre-operative, surgical, and postoperative risk factors were analyzed, and the quality of the evidence gathered was evaluated by performing a best-evidence synthesis. Strong evidence was found for the fact that the type of surgery performed influences how much balance improves. In particular, it was found that surface hip arthroplasty is better than total hip arthroplasty at restoring balance. The less invasive intervention, surface hip arthroplasty, likely causes less damage to the tissues (and therefore to the proprioceptors), consequently leading to a lower impairment of balance [18][19][20][21][22]. Surface hip arthroplasty is also more effective at restoring the correct biomechanics of the hips, since it leads to a more precise reconstruction, in which the hip center of rotation is preserved, thus not modifying the lever arm of the abductor muscle [23]. However, this conclusion is not shared by all authors [24]. In addition, the femoral head of the prosthesis is similar to the native in size and shape, which means that the loading distribution will be closer to physiological conditions than it would if total hip arthroplasty was performed [25]. Unfortunately, surface hip arthroplasty has also some disadvantages such as the risk of femoral neck fractures (associated with the surgeon's learning curve) [26] and of acetabular and femoral component loosening (although quite infrequent) [27]. Moreover, literature reports that metal-on-metal implants are not indicated for patients with chronic kidney disease because of the risk of metallosis [28].

Strong evidence also exists supporting that post-operative training programs improve balance after HA. Different authors analyzed the effects of strength and ROM exercises after surgery. All the authors reported better early functional and balance outcomes compared to those patients who did not perform post-surgery exercises [29][18][19][30][31][32]. Unfortunately, no comparison between different training timing has been performed, since no study reported it.

A moderate level of evidence was found for the beneficial effect of specific balance training following surgery [33][34]. These results are particularly important, as they indicate that balance can be restored effectively even in the early period after surgery, which is when the risk of falling is at its highest. However, one year after the intervention, no differences from the control group were found. Further research efforts should be devoted to investigating how to prolong the positive effects of specific training on balance after the early period following the surgery, in particular by defining which are the most effective post-operative protocols. Training programs typically involve static and dynamic exercises to strengthen the muscles, the proprioception, and the overall balance of the patients, to attain optimal weight distribution symmetry. Unfortunately, while most rehabilitative protocols include a combination of these elements, there is no universal, standard protocol that is superior to the others, thus being used in all situations and for all patients. This leads to the use of many different protocols, making it difficult to determine if post-operative rehabilitation is an effective tool in restoring balance.

Pre-operative factors that may hinder balance recovery were also analyzed. A limited level of evidence was found for the fact that gender, BMI, and sensory-motor training before surgery does not influence balance recovery. Since HA causes impairment of sensory-motor function, sensory-motor training has been proposed as a rehabilitative treatment for a patient undergoing HA. However, the available literature does indicate that this type of treatment is effective at restoring balance. The observed lack of influence of pre-operative training on post-operative balance might be explained by the fact that balance is regulated by systems (i.e., the sensorimotor, visual, and vestibular systems) that might not benefit from the training. Another explanation could be that HA causes damage to the hip joint capsule and the nearby soft tissues rich in proprioceptors, damage that no rehabilitation can reverse. In this regard, different surgical approaches might affect the soft tissues differently. However, conflicting evidence was found regarding the effectiveness of different surgical procedures: anterolateral and posterior approaches were compared since they affect different anatomical structures around the hip. Kiss et al. [35] found that the anterolateral approach leads to better clinical outcomes and to better pelvis motion and gait analysis normalization in the patients they studied, and this finding is reported to be caused by the fact that, in this approach, the gluteus medius and the posterior capsule remain intact, thus enabling the compensatory mechanisms of the pelvis. On the contrary, Holnapy et al. [36] found that the posterior approach was superior at improving balance after THA, suggesting that this approach better preserves the joint capsule, thus sparing more proprioceptors. The type of surgical approach performed influences several aspects related to the clinical outcome other than the restoration of balance, such as the number of complications, the speed of recovery, and the outcome. Nevertheless, there is a need, which should be addressed by further studies, to explain the impact of different surgical procedures on restoring balance, to gain a more complete understanding of the benefits and drawbacks of the type of HA performed. Moreover, it would be interesting for future studies to address the gender differences in restored balance since males and females have different anatomy and degrees of degeneration in somatosensory function [37].

3. Conclusion

In conclusion, though the literature supports the importance to address balance, further studies are needed to identify specific risk factors, and to determine what are the most suitable pre-operative, surgical, and post-operative aspects for the development of protocols to properly manage patients, improving balance and reducing the risk of falls and their dangerous consequences in the fragile elderly population of hip OA patients undergoing hip replacement.

References

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