



Systematic Review

Optimum Positioning for Anteroposterior Pelvis Radiography: A Literature Review

Kholoud Alzyoud, MSc, BSc^{a*}, Peter Hogg, DCR (R), DRI, CI Cert, BSc (Hons), MPhil, PG Cert^a,
Beverly Snaith, PhD, MSc, DCR^{bc}, Kevin Flintham, BSc (Hons), PgDip, MSc^b and
Andrew England, BSc (Hons), PgCert, MSc, PhD^a

^a School of Health Sciences, University of Salford, Salford, UK

^b The Mid Yorkshire Hospitals NHS Trust, Wakefield, UK

^c University of Bradford, Bradford, UK

ABSTRACT

Aim: Pelvic radiography is used for the identification of hip joint changes, including pathologies such as osteoarthritis. Several studies have recommended that the position for this radiological procedure should be standing, not supine, to reflect the functional appearances of the hip joint. The aim of this review was to evaluate pelvis radiography positioning with respect to the image appearances and information provided for clinical decision-making. Aside from this, potential recommendations to the radiographic technique for an erect pelvis projection will be considered.

Method: A literature search was performed using databases/abstract systems (ScienceDirect, Web of Science, PubMed, and MEDLINE). Only articles written in English were included.

Results: Twenty-five articles were identified. Findings from the review describe the effect of repositioning from supine to erect on a series of specific hip measurements. These include pelvic tilt, joint space width, and the acetabular component.

Conclusion: Evidence within the literature illustrates that in several studies, there were differences when repositioning from supine to standing for a number of pelvic metrics. Standing positioning is promoted by some authors since this may facilitate the early diagnosis of hip joint pathology and assist in the planning of surgical interventions. Literature is very limited on how to optimally perform erect pelvis radiography, and this should be an area for future research.

RÉSUMÉ

But : La radiographie pelvienne est utilisée pour l'identification du remplacement de l'articulation de la hanche, y compris les

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pathologies comme ostéoarthrite (OA). Plusieurs études ont recommandé que cette procédure radiologique se fasse en position debout plutôt que couché sur le dos afin de refléter l'apparence fonctionnelle de l'articulation de la hanche. Le but de cette revue de la littérature est d'évaluer le positionnement de la radiographie pelvienne en ce qui a trait à l'apparence de l'image et à l'information fournie pour la prise de décision clinique. La revue examinera également les recommandations potentielles pour la technique d'acquisition d'une projection pelvienne en position de bout.

Méthodologie : Une recherche documentaire a été faite en utilisant des bases de données et des systèmes de résumés (ScienceDirect, Web of Science, PubMed et MEDLINE). Seuls les articles rédigés en anglais ont été retenus.

Résultats : Vingt-cinq articles ont été recensés. Les constats de la revue décrivent les effets d'un changement de la position couchée sur le dos à la position debout sur une série de mesures spécifiques de la hanche, comprenant la bascule du bassin, la largeur de l'espace articulaire et la composante acétabulaire.

Conclusion : Les données probantes fournies par la littérature montrent que des différences sont apparues dans plusieurs études pour différentes mesures pelviennes lors d'un changement de position, de la position couchée à la position debout. La position debout est favorisée par certains auteurs puisqu'elle pourrait faciliter le diagnostic précoce des pathologies de l'articulation de la hanche et aider à la planification des interventions chirurgicales. La littérature est très limitée sur la façon de réaliser de façon optimale des radiographies pelviennes en position debout, un sujet que devrait faire l'objet de recherches futures.

* Corresponding author: Kholoud Alzyoud, MSc, BSc, University of Salford, School of Health Sciences, Salford M6 6PU, UK.

E-mail address: k.alzyoud@edu.salford.ac.uk (K. Alzyoud).

Introduction

Over the past 2 decades, orthopaedic evaluation and treatment of hip pain has improved dramatically [1,2]. This is mainly due to the improved understanding of structural hip pathologies, including acetabular dysplasia of the hip (AD) and femoroacetabular impingement (FAI) [3,4]. AD is an abnormality of the hip joint consisting of an abnormal relationship between the femoral head and acetabulum. The dysplastic acetabulum is shallow and steeply oriented [5]. FAI is the collision between parts of the femoral head and acetabular rim. There are three types of FAI [6]. The first is cam-FAI, in which the deformity occurs at the femoral head junction. The second type is pincer-FAI, where the femoral neck abuts against the acetabular rim and occurs due to the femoral head sitting deep within the acetabulum [7]. The third type is combined impingement, where both cam and pincer types are present. Both AD and FAI are considered early signs of osteoarthritis (OA). OA is expected to become the fourth most common disability in the United Kingdom by 2020 [8], and it is also a leading cause of hip pain [9]. Early diagnosis of people suffering from hip pathology is, therefore, vitally important to ensure appropriate management strategies are established.

Advances in medical imaging equipment such as computed tomography (CT) and magnetic resonance imaging provide three-dimensional images that offer accurate diagnosis for hip joint pathologies [10]. Despite these developments, projection radiography remains crucial in the diagnosis and follow-up of most hip joint disorders such as FAI and AD. Primary reasons behind this are that it is a simple, accessible, and cheap technique with a relatively low radiation dose, and importantly it provides valuable clinical information [11]. Despite these advantages, precise evaluation of the hip joint still poses challenges to the clinician, especially in cases of a mild structural abnormality [4,12].

Alongside visual analysis of the imaging appearances, a number of key radiographic measurements are used in the evaluation of hip anatomy and the diagnosis of hip joint disorders [13,14]. Examples include centre-edge angle (CEA), acetabular index (AI), and joint space width (JSW) that are used to demonstrate AD [5,15]. CEA is the most useful indicator of hip dysplasia, and it is the degree of lateral femoral head coverage in the frontal plane [16]. AI refers to the orientation of the acetabular roof [17] and is increased in developmental dysplasia. Head/neck offset and alpha angle are alternative metrics in the diagnosis of FAI [18–20]. In addition, acetabular morphology is important to identify changes in bony architecture, which may underpin the FAI. JSW is measured at the narrowest point on projection radiography [21] and reduces with joint cartilage loss and OA progression.

Pelvic tilt (PT) is considered one of the most important factors that affect radiographic outcome measures. The pelvis can tilt in a lateral or anteroposterior (AP) orientation, with the former most commonly related to leg length discrepancy and the latter rotation (flexion or extension) of the pelvis and is influenced by posture. PT is measured by defining the angle between the line connecting

the anterior superior iliac spine and posterior superior iliac spine and a horizontal line [22]. Anterior PT rotates the pelvis forward and causes the acetabulum to be orientated posteriorly facing, defined as retroversion. In healthy people, if the pelvic x-ray image is acquired with increased PT, then this will lead to false acetabular retroversion appearances, which can affect the diagnosis of FAI. Ultimately, inaccurate measurements, which may result from radiographic positioning, could lead to inadequate diagnosis and poor quality treatment [11].

Traditionally, an AP pelvis x-ray image is taken with the patient in the supine position. Since hip pain often presents during weight-bearing and daily functional activities, such as walking and running, some advocate that pelvic imaging should be performed in the erect position to provide more clinically useful information [23–25]. Supporting this, several studies have reported that there are changes in the orientation (tilt) of pelvis as the posture changes; that is, moving from supine to standing [26–29].

The aim of this literature review was to evaluate erect over supine pelvic imaging, with respect to imaging appearances and the diagnostic information provided. Aside this, the review will also consider whether recommendations can be provided on the optimum radiographic technique for erect AP pelvis radiography.

Methods

Peer-reviewed literature was selected from four medical journal databases: ScienceDirect, Web of Science, PubMed, and MEDLINE. Search terms used Medical Subject Headings (MeSH), and key words included hip, pelvis radiography, standing and supine pelvis, erect pelvis, weight-bearing, total hip replacement, OA, dysplasia, FAI, developmental dysplasia of hip. Only articles written in English were included. There were no time limitations placed on the search; this was to ensure that significant seminal studies were included. The search used Boolean operators (AND, OR, and NOT) to further narrow the results. To ensure that the information used within the review was accurate, only submissions from peer-reviewed journals were selected. Furthermore, only those articles with unrestricted accessibility to their full text were considered eligible for inclusion. Publications that only used standing and supine positions were also included. Articles that did not involve projection radiography, such as magnetic resonance imaging and ultrasound, were excluded. However, articles focussing on the differences between the two positions, but using other imaging modalities, were included if deemed relevant. Moreover, the articles that used the two positions (erect and supine) for other body parts were also removed. Further details of the literature search and identification processes are detailed in Figure 1.

Results

Twenty-five articles were identified using the previously defined search criteria, with a large proportion emanating from mainland Europe. Key aspects of the articles are summar-

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