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The Value of Axial Imaging to Check Reduction after Anterior Approach Open Reduction for Developmental Dysplasia of the Hip

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Abstract

Background: There are still many controversies regarding the diagnosis and management of developmental dysplasia of the hip (DDH). Axial imaging is routinely used after closed or open reduction to confirm reduction has occurred. In this study, we aimed to determine the rate of early re-dislocation or failure of reduction after anterior approach open reduction (AOR), to establish whether there is a true need for routinely performing post-operative axial imaging.

Methods: We retrospectively reviewed radiographs, operation notes and post-operative CT scan images of our AOR cases from September 2018 to June 2020. The CT scan images were reviewed to check the post-operative reduction and congruency. The 'posterior neckline' and the 'modified Shenton line' were used to assess reduction. The related literature was also reviewed.

Results: Thirty patients were included. The post-operative CT scans confirmed that all cases had reduced congruent hips. The CT scans did not change future treatment plans for any patient in this cohort and did not predict late re-dislocation.

Conclusions: The rate of early re-dislocation or failure of reduction after AOR was negligible. Traditional routine axial imaging after this operation is therefore unjustified and has no value in predicting possible late re-dislocations. It also comes at the cost of extra radiation to the child and expense for the health system. We recommend stopping the routine use of post-operative axial imaging and using it selectively for specific indications, including teratologic and neuromuscular hips, bilateral DDH, and after revision surgery, in addition to closed reductions and medial approach open reduction.

Keywords: Axial imaging, CT scan, dysplasia of the hip, open reduction, anterior approach, checking reduction

Level of evidence: IV.

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INTRODUCTION

The incidence of dysplasia of the hip (DDH) is about 1:100 live births [1]. With the introduction of screening programs, the incidence of surgical intervention has significantly dropped. However, there are still cases that fail conservative methods or present for the first time after walking age and which therefore require surgery. This is particularly common in developing countries, where screening programs are not well established.

It is a common practice in many parts of the world to obtain an axial form of imaging after DDH closed and open reductions to check for congruent reduction [1–6]. CT and MRI scans are both used for this purpose. A CT scan is the image of choice in most places as it is cheaper, quicker, more available and less likely to require sedation compared to an MRI. In this study, we determine the rates of early re-dislocation and reduction failure after anterior approach open reduction (AOR); we also examine the need for performing post-operative axial imaging.

MATERIALS AND METHODS

Ethical approval was obtained from the local ethical committee of the Hashemite University–Zarqa Jordan, Approval number 2020/2019/12/7 prior to data collection. We explored our orthopedic department's database and found 90 patients who had been admitted with a diagnosis of DDH from

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September 2018 to June 2020. We excluded all cases of arthrogram only, closed reduction, spica changes, and pelvic and/or femoral osteotomies with or without open reduction. Patients in this study had had open reduction only without osteotomies. Some 27 patients (30 hips) met the criteria, aged between 12–35 months (mean 18 months). A single surgeon performed all operations. The patients' demographics and operative details are summarized in Table 1. We reviewed the operation notes, pre-operative x-ray images, saved intraoperative C-arm images and post-operative CT scan images and radiology reports for all patients. We hypothesized that there is no need for routine axial imaging after AOR as the rate of early re-dislocations is negligible and because, we believed, axial imaging has no predictive value in detecting patients at risk of late dislocation. We also reviewed the relevant literature via a PubMed search.

Table 1: Patient demographics and details of performed procedures

Gender	Males (n=7)	Females (n=20)	
Operated side	Right (n=7)	Left (n=17)	Bilateral (n=3)
IHDI classification	III (n=11)	IV (n=19)	

Surgical technique

The same surgical technique was used for all patients, in that the patient was placed supine on the operating table with a small sandbag under the operated side. Percutaneous adductor tenotomy was done and the anterior approach to the hip joint was made via a Smith-Peterson interval. Iliopsoas recession was done at the pelvic brim for all cases. A T-shaped capsulotomy was done, the ligamentum teres and pulvinar were excised, and the transverse acetabular ligament released. The hip was reduced under vision and confirmed with C-arm imaging, following which a standard capsulorrhaphy was performed. The femoral head was palpated under the repaired capsule to confirm reduction. A double full-length spica was applied in all cases and retained for 6–8 weeks.

Post-operative CT scan

All patients had a post-operative CT scan to ensure the hip was reduced and congruent. A Philips Incisive CT machine 128 slice configuration (Philips Healthcare, Cleveland Ohio) was used with a 1 mm slice thickness, kilo-voltage (KV) 90–120 iDose 4 to reduce radiation exposure. The CT scan was performed on the same or following day as the surgery. A low-dose CT was performed with limited cuts centered on the tri-radiate cartilage as per the pediatric radiology department protocol. All patients had at least axial and coronal cuts. All scans were reviewed by the senior author for reduction and congruity and by a pediatric radiologist. The 'posterior neckline' was the primary measure, but the modified Shenton line was also used.

RESULTS

Thirty hips in 27 patients matched our inclusion criteria. Three patients with bilateral DDH (six hips) had simultaneous bilateral open reductions, while the remainder of the patients had unilateral open reductions. In all cases, the surgical notes recorded that the femoral head had been reduced under vision and without tension into the acetabulum after removing all obstacles. The capsuloplasty technique was the same for all patients. The femoral head was palpated under the repaired capsule. Intra-operative C-arm images were obtained after capsuloplasty confirming the reduction.

The post-operative CT scans showed that all hips were reduced. All scans showed that the 'posterior femoral neckline' crossing the acetabulum at a point anterior to the transitional area, between the acetabular concavity and posterior wall convexity in the dysplastic S-shaped acetabulum indicating a congruent reduction, as per Cooper et al [1] (Figure 1). All scans also had a normal modified Shenton line, which is used to assess the antero-posterior displacement of the proximal femoral metaphysis in relation to the acetabulum on the axial CT cut. The anterior femoral neck on the axial cut should be anterior to the line drawn from the pubis [2] (Figure 2). The radiology report noted that the operated hip was 'reduced' in all patients.

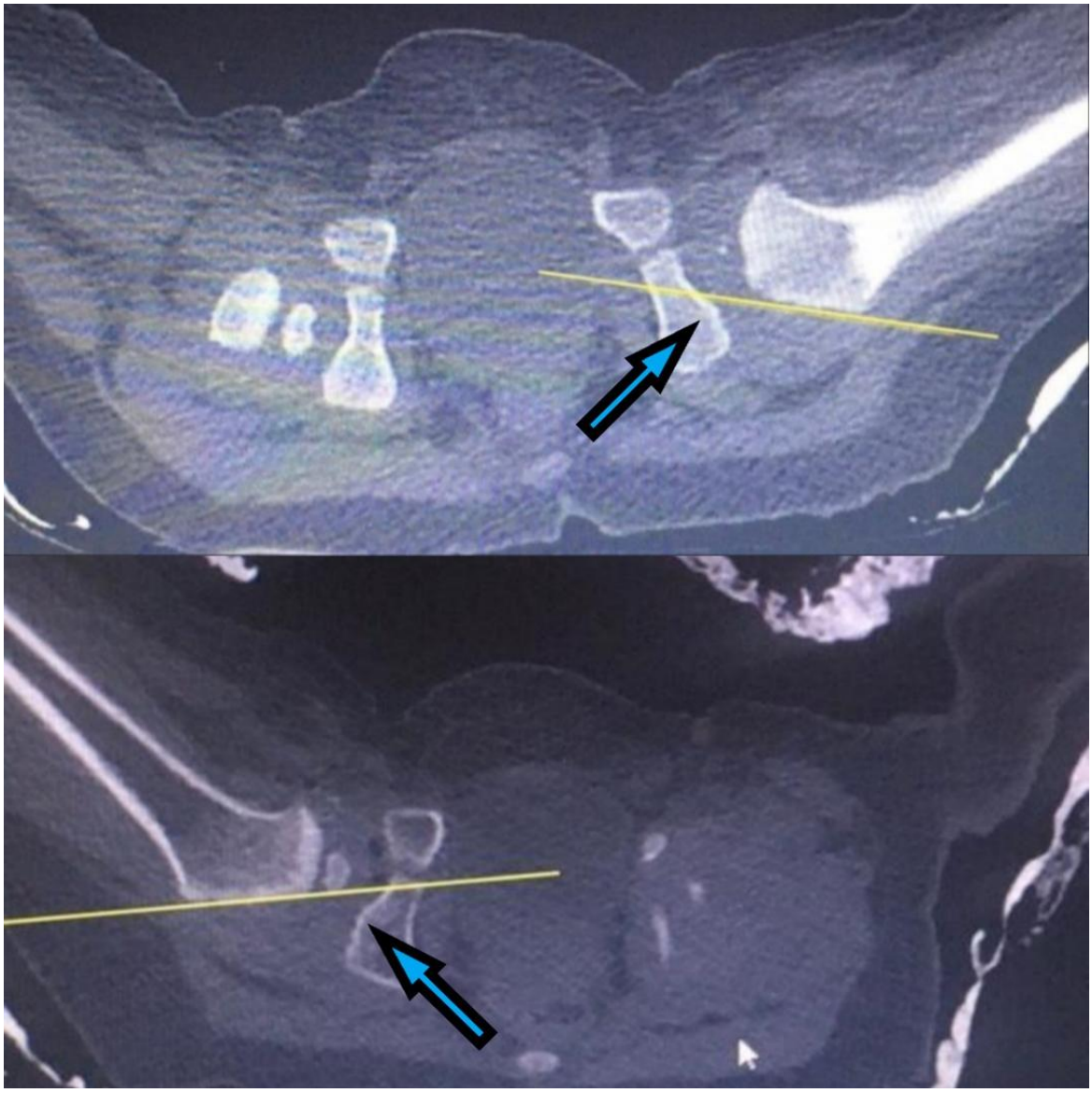

Figure 1: Post-operative CT axial cuts in a patient with left DDH, showing a normal 'posterior neckline' after the anterior approach open reduction. The yellow line drawn along the posterior femoral neck crosses the acetabulum anterior to the point of transition from concavity to convexity (blue arrow). The contralateral normal hip is also shown in the bottom CT cut.

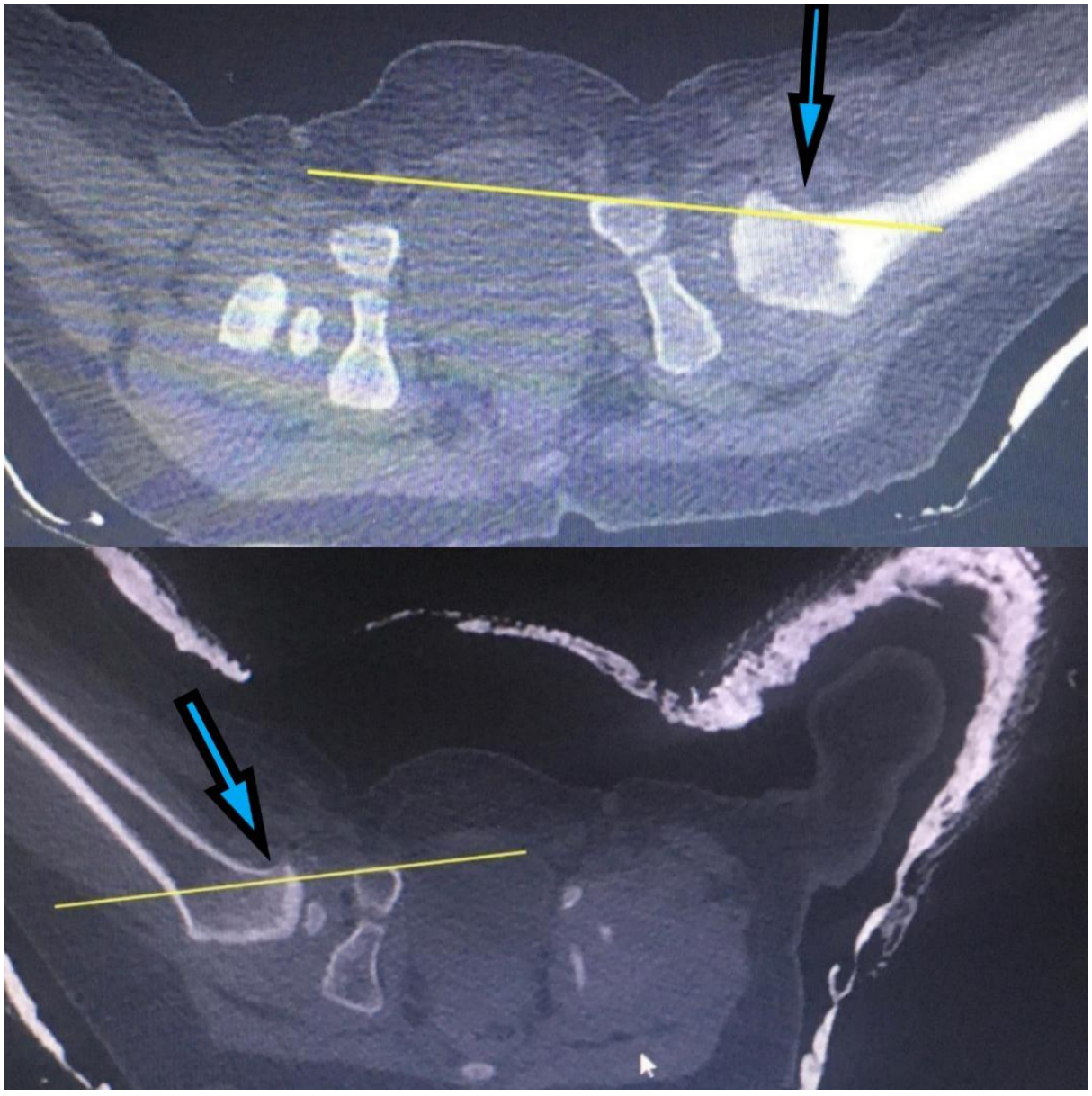

Figure 2: Post-operative CT axial cuts in a patient showing a normal 'modified Shenton line' after anterior approach open reduction. The line drawn along the anterior pubis (in yellow) should lie posterior to the anterior aspect of the femoral neck (blue arrow). Operated left hip above. Normal right hip below

DISCUSSION

Post-operative x-rays alone cannot accurately confirm hip reduction, especially in the 'human frog position' with a hip spica in place [3]. For this reason, axial imaging was introduced to check for femoral head reduction after closed and open reductions for DDH [4–7]. The theoretical benefit of axial imaging is to detect early re-dislocation in order for an early intervention to be made.

CT and MRI scans can both be used for this purpose, and their sensitivity and specificity after DDH surgery are excellent [8]. They have excellent inter- and intra-observer reliability [9]. CT scans are quick, relatively cheap, widely available and

performed without sedation. On the other hand, MRI scans show the articular cartilage and theoretically can be superior in showing the congruency of the hip joint [10, 11]. MRI, which has the advantage of lacking ionized radiation [12], is thought by some to be better as it can show soft tissue obstacles to reduction [13, 14], hence its importance after closed reductions. Obviously, in AOR, all these obstacles are removed under vision during surgery. This may explain the higher rate of late re-dislocations after closed reductions (8 times higher than ORs) [15]. This also—in our opinion—raises a question about the need for performing any axial imaging after AOR.

Some authors have studied the role of axial imaging in detecting early dislocations after closed and open reductions. In [16], it was concluded that MRI has a role after closed but not open reductions. Another paper reported the use of MRI after 12 open reduction cases, all of which had reduced hips post-operatively [17].

Our results show that CT scans are not needed after open DDH reduction via AOR as the incidence of immediate re-dislocation is negligible. Visualizing the reduction intra-operatively and performing a capsuloplasty seem to be the most important factors in confirming reduction. Palpation of the femoral head under the capsule after capsuloplasty is also useful for checking the reduction. Intra-operative X-rays, although not fully accurate, can be taken before spica application and are clearer than post-operative X-rays, thus helping the surgeon to check the reduction.

The literature clearly shows that early re-dislocations are extremely rare after AOR, and therefore the routine use of axial imaging to check the reduction is unjustified. The rate of immediate re-dislocation after AOR in the literature is 0–2%, although some studies included medial approach open reductions (MAOR) in their cohort [17–21]. Furthermore, axial imaging also has no predictive value for anticipating late re-dislocations [20, 21]. Since MRI can show soft tissue obstacles to reduction, it can be helpful in closed reductions but not after open reductions [16]. The previous literature has defined particular at-risk groups of patients for re-dislocation. Most of these re-dislocations are late and not detected on post-operative CT or MRI scans. These groups include bilateral DDH [21], teratological and neuromuscular hips [21], and revision surgery [16, 21].

We do not use MAOR in our department, and indeed more research is required to determine the need for axial imaging after this approach. We believe that capsulorrhaphy, which is only performed via AOR, is particularly important in maintaining the reduction. Therefore, the results of our study and our conclusions do not apply to MAOR.

Our study showed that all 30 hips were reduced on post-operative CT scans after AOR. There were no changes in the short-term treatment plan based on the CT. From our results and previous data in the literature, we found that AOR carries little or no risk of immediate re-dislocation. Furthermore, CT and MRI have no predictive value for detecting late re-dislocations and, thus, we conclude that axial imaging should not be routinely used to check reduction after AOR. This will reduce the children's exposure to radiation and also save resources. We recommend—based on other available literature—using selective axial imaging for very specific indications, such as bilateral DDH, and teratologic and neuromuscular dislocations, as well as in difficult and revision surgery, closed reductions, and medial approach open reductions.

Highlights

- Open reduction for DDH is a common operation. Axial imaging (CT or MRI) is commonly used in the immediate post-operative period to check the reduction.
- We hypothesized that axial imaging is not required if a good surgical technique is used.
- We recommend stopping the use of axial imaging after anterior approach open reductions, to reduce radiation exposure and save resources.

The study was conducted at Prince Hamza Hospital, Amman, Jordan.

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REFERENCES

1- Cooper A, Evans O, Ali F, Flowers M. A Novel Method for Assessing Postoperative Femoral Head Reduction in Developmental Dysplasia of the Hip. J Child Orthop 2014 Aug; 8(4):319–24.
2- Smith BG, Mills MB, Hey LA, Jaramillo D, Millis MB. Postreduction computed tomography in developmental dislocation of the hip: part I: analysis of measurement reliability. J Pediatr Orthop 1997 Sep–Oct; 17(5):626–630.
3- Hernandez RJ. Concentric reduction of the dislocated hip. Computed-tomographic evaluation. Radiology 1984 Jan; 150(1): 266–8.
4- Stanton RP, Capecci R. Computed tomography for early evaluation of developmental dysplasia of the hip. J Pediatr Orthop 1992 Nov–Dec;12(6):727–730
5- Browning WH, Rosenkrantz H, Tarquino T. Computed tomography in congenital hip dislocation: the role of acetabular anteversion. J Bone Joint Surg Am 1982 Jan; 64(1):27–31.
6- Edelson JG, Hirsch M, Weinberg H, Attar D, Barmeir E. Congenital dislocation of the hip and computerised axial tomography. J Bone Joint Surg Br 1984 Aug; 66(4):472–478.
7- Grissom L, Harcke HT, Thacker M. Imaging in the surgical management of developmental dislocation of the hip. Clin Orthop Relat Res 2008 Apr; 466(4):791–801
8- Chin MS, Bet BW, Halanski MA. Comparison of Hip Reduction Using Magnetic Resonance Imaging or Computed Tomography in Hip Dysplasia. J Pediatr Orthop 2011 Jul–Aug; 31(5):525–9.
9- Barkatali BM, Imalingat H, Childs J, Baumann A, Paton R. MRI Versus Computed Tomography as an Imaging Modality for Post reduction Assessment of Irreducible Hips in Developmental Dysplasia of the Hip: An Interobserver and Intraobserver Reliability Study. J Pediatr Orthop B 2016 Nov; 25(6):489–92.
10- Buckley SL, Sponseller PD, Magid D. The acetabulum in congenital and neuromuscular hip instability. J Pediatr Orthop 1991 Jul-Aug; 11(4):498–501
11- Guidera KJ, Einbecker ME, Berman CG, Ogden JA, Arrington JA, Murtagh R. Magnetic resonance imaging evaluation of congenital dislocation of the hips. Clin Orthop Relat Res 1990 Dec; 261:96–10
12- Lang P, Genant HK, Jergesen HE, Murray WR. Imaging of the Hip Joint. Computed Tomography Versus Magnetic Resonance Imaging. Clin Orthop Relat Res 1992 Jan; (274):135–53.
13- Barrera CA, Cohen SA, Sankar WN, Ho-Fung VM, Sze RW, Nguyen JC . Imaging of Developmental Dysplasia of the Hip: Ultrasound, Radiography and Magnetic Resonance Imaging. Pediatr Radiol 2019 Nov; 49(12):1652–1668.
14- Dibello D, Odoni L, Pederiva F, Di Carlo V. MRI in Postreduction Evaluation of Developmental Dysplasia of the Hip: Our Experience. J Pediatr Orthop 2019 Oct; 39(9):449–452.
15- Case RD, Gargan MF, Grier D, Portinaro NMA. Confirmation of the reduction and containment of the femoral head with CT or MRI scans in DDH: The need for repeated scans. Hip Int 2000 Jan; 10(2): 118–22.
16- Siddharth P Jadhav , Snehal R, Zhang W, Herman Kan J. Utility of Immediate Postoperative Hip MRI in Developmental Hip Dysplasia: Closed vs. Open Reduction. Pediatr Radiol 2018 Aug; 48(8):1096–1100.
17- Ranawat V, Rosendahl K, Jones D. MRI After Operative Reduction With Femoral Osteotomy in Developmental Dysplasia of the Hip. Pediatr Radiol 2009 Feb; 39(2):161–3.
18- Alassaf N, Abuhaimed J, Almahmoud N, Binkhulaif R. The Added Value of Postoperative Axial Imaging in Developmental Dysplasia of the Hip. Open Orthop J 2017 Jul. 26 (11):567–576.
19- Eberhardt O, Zieger M, Langendoerfer M, Wirth T, Fernandez FF. Determination of Hip Reduction in Spica Cast Treatment for DDH: A Comparison of Radiography and Ultrasound. J Child Orthop 2009 Aug; 3(4):313–8.
20- Eberhardt O, Zieger M, Wirth T, Fernandez FF. [Determination of Femoral Head Position with Transinguinal Ultrasound in DDH Treatment]. Z Orthop Unfall 2009 Aug; 147(6):727–33.

Sankar WN, Young CR, Lin AG, Crow SA, Baldwin KD, Moseley CF. Risk Factors for Failure after Open Reduction for DDH: A Matched Cohort Analysis. J Pediatr Orthop 2011 Apr–May; 31(3):232–9.

هل هناك ضرورة لإجراء تصوير محوري للتأكد من رجوع المفصل لمكانه بعد عملية رد المفصل المفتوح عبر الجراحة الأمامية لحالات خلع الورك التطوري

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الملخص

الخلفية والأهداف : لا تزال هناك العديد من نقاط الخلاف حول تشخيص وعلاج حالات خلع الورك التطوري. يستخدم التصوير المحوري بشكل روتيني بعد عمليات رد المفصل المغلق والمفتوح للتأكد من رجوع المفصل لمكانه. تهدف الدراسة لتحديد نسبة عدم رجوع المفصل بعد عمليات الرد المفتوح عبر الجراحة الأمامية وذلك لتحديد ان كان هناك داعٍ لإجراء التصوير المحوري.

منهجية الدراسة :: تمت مراجعة جميع الحالات بين شهر أيلول 2018 لغاية شهر حزيران 2020. تمت مراجعة جميع صور الأشعة السينية والمحورية وملفات المرضى و تقارير العمليات. تمت أيضاً مراجعة الأبحاث المنشورة التي تخص هذا الموضوع.

النتائج: تمت دراسة 30 حالة في هذه الدراسة. الصور الطبقية المحورية أكدت رجوع المفصل لمكانه عند جميع المرضى ولم تغير الصور المحورية الخطة العلاجية لأي من المرضى

الاستنتاجات : نسبة استمرار الخلع بعد عمليات رد المفصل المفتوح عبر الجراحة الأمامية لا تذكر. لذلك نوصي بالتوقف عن استخدامه

الكلمات الدالة: التصوير المحوري، التصوير الطبقي، خلع الورك التطوري، رد المفصل، الجراحة الأمامية، التأكد من رجوع المفصل.