

Day-case pelvic osteotomy for developmental dysplasia of the hip

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Abstract

Purpose: In this article we report the results of a pilot study analysing the implications of performing pelvic osteotomies for developmental dysplasia of the hip (DDH) as a day case. We assess the advantages of performing paediatric pelvic osteotomies as day-case procedures from a financial perspective and from an in-patient bed resource point of view.

Methods: This was a prospective cohort study analysing Salter and Pemberton pelvic osteotomies performed for DDH over a three-year period from 1st January 2017 to 30th September 2019. All patients residing within 50 km of the hospital were eligible for day-case procedures. All other cases were performed as in-patients. A detailed financial costing analysis was performed and the in-patient resources utilized were documented and compared between the two models of care.

Results: In total, 84 Salter and Pemberton osteotomies were performed between 1st January 2017 to 30th September 2019. Of these cases, 35 were performed as day-case procedures. A total reduction in 70 in-patient bed days was reported. Total costs for a single in-patient requiring two nights of admission amounted to €5,752, whereas the discharge cost of a day case was reported at €2,670. The savings made by our institution amounted to €3,082 per day case. A total saving of €102,696 was made over three years. In all, seven day-case patients re-attended due to inadequate pain control. They required overnight admission and were discharged uneventfully the following day.

Conclusion: Day-case pelvic osteotomies significantly reduce the number of in-patient bed days used in an elective paediatric orthopaedic setting. Significant financial savings in excess of €3,000 per case are possible. The introduction of day-case pelvic osteotomy procedures can significantly improve the

cost-effectiveness of managing DDH provided there are clear protocols in place with close clinical follow-up.

Level of evidence: IV

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Purpose

Developmental dysplasia of the hip (DDH) in Ireland has an incidence of 6.73 per 1,000 live births¹ and leads to a significant number of referrals to orthopaedic services annually. This high demand has encouraged the drive to optimize the efficiency of service provision in the paediatric orthopaedic setting.

To date, in the literature there are no studies describing the benefits of performing pelvic osteotomies as day-case procedures in a paediatric population. In this pilot study, we describe the introduction of a novel day-case pelvic osteotomy initiative in a tertiary referral centre. We describe the clinical and administrative support structures required to safely introduce this service.

Methods

This was a non-randomized prospective cohort pilot study conducted to compare conventional in-patient pelvic osteotomies with day-case pelvic osteotomies performed between 1st January 2017 and 30th September 2019. Four paediatric orthopaedic surgeons with a specialist interest in paediatric DDH were involved in performing all osteotomies.

Inclusion criteria for the day-case pelvic osteotomies were as follows:

1. Diagnosis of DDH.
2. Osteotomy type (Salter's and Pemberton's only).
3. Patient proximity to hospital (address within 50 km of hospital).
4. ASA grade I or II.

Exclusion criteria were as follows:

1. Obstructive sleep apnoea.
2. Inability to comply with a predetermined analgesic protocol.

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Only patients fulfilling all the above criteria were considered for day-case pelvic osteotomies. Information was collected prospectively by DDH clinical nurse specialists and recorded in our local DDH database. Clinical parameters recorded included age, gender, DDH risk factors, unscheduled post-operative re-attendances to the emergency department (ED) or out-patient department and readmission for any reason. The primary parameters assessed included clinical and radiographic outcomes. The financial implications of this novel process and the reduction in in-patient resources were included in the secondary outcomes of the study.

For all cases included in the day-case group, a strict protocol involving anaesthetic, surgical and nursing staff was implemented from the time of admission through to discharge as follows.

Pre-operative preparation

All parents of patients eligible to undergo day-case surgery were informed of the need to assess pain and administer regular analgesia at home post-operatively. A leaflet with all relevant information was provided along with a

Managing Pain After Hip Surgery in Children

1 **Give the regular pain medication as prescribed.**

This means **REGULAR** Paracetamol and Ibuprofen together every 6 hours (4 times a day) and a dose of Morphine in the morning for the first three days.

2 **Write it down.**

Recording what was given and when helps prevent missed doses or mistakes.

Paracetamol: 0800, 1400, 2000, 0200.
Ibuprofen: 0800, 1400, 2000, 0200.
Morphine: 0800 on Days 1 to 3.

STEP 1
Give both these medications together every 6 hours:

Paracetamol: Mild painkiller; Give mls of liquid. [Dose is mg].

Ibuprofen: Reduces pain & swelling; Give mls of liquid. [Dose is mg].

If using a new or different bottle from the one provided, make sure the doses in mg are the same as written above!

STEP 2
Morphine: stronger painkiller to give if your child is still in pain.

Give mls of Morphine from the bottle provided. [Dose is mg].

- Record each dose below to avoid giving 2 doses very close together.
- Can be given up to every 4 hours as needed.
- Observe for side effects such as snoring or excessive drowsiness for 2 hours after each dose.

3 **Pain relief is not only about medication.**

Remember that physical (heat, position, food) and psychological (distraction, reassurance) methods can also be very effective. Go to <http://www.mychildisinpain.org.uk/> for further advice and examples.

4 **Use this score to assess pain.**

My child's behaviour	Yes score 1 point each	No score 0 points each
Complains more than usual?		
Cries more easily than usual?		
Plays less than usual?		
Does not do the things he/she usually does?		
Acts more worried than usual?		
Quieter than usual?		
Has less energy than usual?		
Refuses to eat?		
Eats less than usual?		
Holds the sore part of his/her body?		
Tries not to bump the sore part?		
Groans or moans more than usual?		
Looks more flushed than usual?		
Wants to be close to you more?		
Takes medicines that they usually refuse?		
Total Score		

5 **What to do next?**

- If the score is more than 6, that means they might still be in pain.
- Extra morphine doses can be given every 4 to 6 hours as needed.
- The DDH Clinical Nurse Specialist will be in touch on Day 1 after surgery.
- After that, it will be up to you to contact us.

Fig. 1 Parent analgesia leaflet.

prescription for oral Morphine to ensure they had necessary analgesia on discharge (Fig. 1).

Operative technique

Salter's and Pemberton's osteotomies were performed using well-described and standard surgical techniques.

Intra-operative analgesia

All patients received a general anaesthetic. Analgesia consisting of Diclofenac 1 mg/kg was administered either per rectum or intravenously Dexamethasone 0.15 mg/kg IV and Clonidine 1-1.5 mcg/kg IV were also administered intraoperatively. All patients had a single-shot caudal epidural injection or fascia iliaca block with Magnesium Sulphate as an additive. If a block was not possible or failed, the alternative regimen of Morphine 0.2 mg/kg intramuscularly and Lidocaine 2 mg/kg IV was used. All patients were placed in a hip abduction orthosis directly after their osteotomy.

Post-operative analgesia

Standardized post-operative analgesics were used in all cases. Regular Paracetamol (15 mg/kg six-hourly by mouth and Ibuprofen (7.5 mg/kg six-hourly PO) were prescribed for 48 hours. Set times for administration and the dose of each medication were written on the parent information sheet provided before the operation (Fig. 1).

For oral morphine, the solution (Morphine sulphate (Oramorph) 10 mg/5 ml oral solution), individual dose (0.15 mg/kg to 0.2 mg/kg to nearest round number), total dose (prescription should specify a total of eight doses allowing three regular AM doses and at least three as-required doses, allowing for spillage/wastage/imprecise measurement), and timing (one dose in the morning on post-op days one, two and three with regular simple analgesics. As-required doses may be given every six hours as needed thereafter) were all provided in detail.

On the first post-operative day, all parents received a phone call from the DDH clinical nurse specialist to ensure there were no concerns from the parents' perspective. Clinical review was arranged as per standard practice. All patients had follow-up clinic visits at six weeks.

In February 2018, the 'HSE Annual Report and Financial Statements 2018' was published.² This contained the specific total costs of performing paediatric pelvic osteotomies as day-case procedures and as standard in-patient procedures. Using this information we extrapolated the 'total discharge cost' (i.e. the complete cost to the hospital) for both day-case and conventional in-patient pelvic osteotomies. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) checklist was adhered to throughout the study³. Simple descriptive statistics were used to describe our findings.

Results

In total, 84 Salter and Pemberton osteotomies were performed between 1st January 2017 and 30th September 2019. Of these, 35 patients met the day-case inclusion criteria. The remaining 49 patients were treated as in-patients. The length of stay for all cases in the in-patient group was two days. Since all day cases were discharged home on the same day, there was a total reduction of 70 in-patient bed days reported over the 33-month period.

Based on the 'HSE Specialty Costing Report',³ the 'total discharge cost' for patients undergoing an in-patient osteotomy was €5,752 per patient. In contrast, the total discharge cost of performing the procedure as a day case was reported at €2,670 per patient. For 35 day-case patients the total cost to treat amounted to €93,450. Calculating the difference, there was a total saving of €102,696 made by the hospital for the 35 day cases between 1st January 2017 and 30th September 2019. This amounted to €3,082 saved for every day-case osteotomy performed.

Three patients in the day-case group were kept in overnight due to pain control or parental concern and four patients had unscheduled presentations to the ED on post-operative day two due to inadequate analgesic control secondary to non-compliance. These seven patients were kept in hospital overnight for analgesic optimization and had an uneventful discharge the following day. The total cost of ED attendance and one overnight admission was €1,248. Therefore, adjusting for the four re-admissions in the day-case group, the overall saving to our institution with the introduction of this novel day-case model of care was €97,704.

The other 28 day-case patients reported adequate pain control with no concerns warranting re-attendance. All patients were followed up six weeks later in the out-patient clinic. There were no recorded cases of wound infection, hardware failure, osteotomy displacement or reoperation in the day-case cohort.

Clinical and radiographic outcomes were the same in both groups with no complications reported on follow-up.

Discussion

Out-patient operative activity is becoming more widespread. We describe the first application of day-case orthopaedic paediatric osteotomies in the literature. We have shown that day-cases are equally safe, radiographically equal and financially preferable to the traditional in-patient model of care.

Day-case surgical procedures have been introduced with notable success in other areas such as trauma, knee, hip and shoulder arthroplasty.^{2,3,4,5,8,9} Evidence suggests that day-case surgery is a welcome development among patients availing of this service.⁸ However, there

are numerous factors to consider in order to succeed in establishing an out-patient programme, including the presence of a clinical nurse specialist, careful patient selection, pre-operative patient education and specialized protocols.¹⁰

Leroux et al concluded that 30-day adverse event and readmission rates for total shoulder arthroplasty were not significantly different between in-patients and out-patients.⁶ Although there are concerns around early readmission rates in some studies for out-patient surgery, our findings corroborate the theory that, for selected surgical candidates undergoing a suitable surgical procedure, day-case surgery is safe. We report no negative outcomes in the day-case cohort compared to the in-patient group in this study.

Some patients may have comorbidities which make them poor candidates for day-case procedures and general anaesthesia. Proper patient selection and education and a well-defined clinical pathway are all key for successful day-case surgery.¹¹

Shaw et al concluded that pre-operative admission status had no effect on peri-operative complications, readmission or unplanned operation rates and deemed out-patient spinal lengthening to be safe.¹² Similarly, Stull et al compared the outcomes and cost-effectiveness of out-patient versus in-patient ankle fracture surgery on a selected cohort.⁹ Our findings also confirm the cost-effectiveness of day-case surgery as there was a significantly decreased cost for the out-patient group compared to in-patient cases. Stull also noted that if implemented on a national level in the United States, out-patient surgery for ankle fractures would lead to a \$376,705,438 saving for the treatment of the same injuries.⁹ We project that in one year, if all suitable paediatric pelvic osteotomies for DDH were performed as day cases for 84 cases, our institution will save €258,888 and reduce the in-patient burden by 168 bed days per annum.

Day-case procedures are not without risk however. In a retrospective review to determine complication rates associated with out-patient total knee arthroplasty compared with in-patients, Arshi et al found that day cases were more likely to undergo revision, explanation of the prosthesis and manipulation under anaesthesia within one year.¹¹ Higher incidences of post-operative deep vein thrombosis were also noted in this article.

We recognize that prior to implementation of a day-case surgical programme, the inclusion and exclusion criteria must be rigid and safe regarding potentially complicated patients. We acknowledge the importance of the multi-disciplinary approach to the safe introduction of an initiative such as this. Further larger-scale studies will be continued in our institution to supplement the pilot study reported here.

Limitations

There are limitations to our study. Overall, numbers are relatively small, meaning that a larger sample size may detect true differences in clinical or radiographic outcomes. Patient samples were not randomized, however, on comparison, there were no differences in the demographics or risk factors for the two groups. Certain patients underwent conventional in-patient osteotomy as this was the surgeon's preference. We are now in the process of an institutional move towards day-case osteotomy for all patients.

Conclusion

We have shown that day-case pelvic osteotomy surgery for DDH is a safe and cost-effective initiative that significantly reduces the demand on in-patient hospital bed resources. Savings of €3,082 per day case have significant future financial implications for all treating institutions. This novel out-patient model of care is also clinically equivocal to the traditional in-patient model of care for DDH osteotomies.

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COMPLIANCE WITH ETHICAL STANDARDS

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OA LICENCE TEXT

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ETHICAL STATEMENT

Ethical approval: Ethical approval was administered by the Hospital Ethics board. All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed consent: Informed consent was received from all patients to be enrolled in the study as a day case.

ICMJE CONFLICT OF INTEREST STATEMENT

None declared.

AUTHOR CONTRIBUTIONS

DMM: Prepared manuscript and performed measurements.

GS: Prepared manuscript and performed measurements.

PMK: Study design.

DPM: Study design.

REFERENCES

1. **Phelan N, Thoren J, Fox C, O'Daly BJ, O'Beirne J.** Developmental dysplasia of the hip: incidence and treatment outcomes in the Southeast of Ireland. *Ir J Med Sci* 2015;184:411-415.
2. **Health Service Executive.** HSE annual report and financial statements 2018. <https://www.hse.ie/eng/services/publications/corporate/hse-annual-report-and-financial-statements-2018.pdf> (date last accessed 6 October 2020).
3. **University of Bern 2009.** STROBE statement: strengthening the reporting of observational studies in epidemiology. <https://www.strobe-statement.org/index.php?id=strobe-groupo> (date last accessed 6 October 2020).
4. **Nelson SJ, Webb ML, Lukasiewicz AM, Varthi AG, Samuel AM, Grauer JN.** Is outpatient total hip arthroplasty safe? *J Arthroplasty* 2017;32:1439-1442.
5. **Larsen JR, Skovgaard B, Prynø T, et al.** Feasibility of day-case total hip arthroplasty: a single-centre observational study. *Hip Int* 2017;27:60-65.
6. **Leroux TS, Basques BA, Frank RM, et al.** Outpatient total shoulder arthroplasty: a population-based study comparing adverse event and readmission rates to inpatient total shoulder arthroplasty. *J Shoulder Elbow Surg* 2016;25:1780-1786.
7. **Huang A, Ryu JJ, Dervin G.** Cost savings of outpatient versus standard inpatient total knee arthroplasty. *Can J Surg* 2017;60:57-62.
8. **Gonzalez T, Fisk E, Chiodo C, Smith J, Bluman EM.** Economic analysis and patient satisfaction associated with outpatient total ankle arthroplasty. *Foot Ankle Int* 2017;38:507-513.
9. **Stull JD, Bhat SB, Kane JM, Raikin SM.** Economic burden of inpatient admission of ankle fractures. *Foot Ankle Int* 2017;38:997-1004.
10. **Register JL, Head PJ, Orteneau G.** Establishing a successful outpatient joint arthroplasty program. *AORN J*. Jul;108:44-50
11. **Arshi A, Leong NL, D'Oro A, et al.** Outpatient total knee arthroplasty is associated with higher risk of perioperative complications. *J Bone Joint Surg [Am]* 2017;99:1978-1986.
12. **Shaw KA, Fletcher ND, Devito DP, Murphy JS.** Complications following lengthening of spinal growing implants: is postoperative admission necessary? *J Neurosurg Pediatr* 2018;22:102-107.