

Technical Note

Percutaneous screw fixation of pubic symphysis disruption

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ABSTRACT

Percutaneous fixation of the pubic symphysis is a relatively novel treatment strategy in the management of pelvic ring injuries with symphyseal disruption. While the current gold standard for surgical treatment of pubic symphysis diastasis is open reduction and plate fixation, high rates of implant failure and recurrent diastasis persist. Furthermore, blood loss, operative time, and postoperative infection associated with open approaches to the pelvis should be considered. Percutaneous fixation of the posterior pelvic ring has proven to be safe and effective. Percutaneous fixation of the pubic symphysis has been described in China and Spain, with promising results. We present here our surgical technique for percutaneous reduction and fixation of the pubic symphysis with emphasis on the risks to nearby anatomic structures.

Introduction

Pubic symphysis disruptions occur in approximately 15–20 % of pelvic ring injuries and are commonly the result of high energy trauma, most often arising from anterior posterior compression type mechanisms [1,2]. Initial treatment of patients with symphyseal disruptions consists of resuscitation, along with the identification and treatment of associated injuries. The management of hemodynamic instability owing to pelvic bleeding varies among institutions, but commonly includes pelvic binder application, external fixation, emergency angiography/embolization, and pelvic packing [3]. The definitive treatment of symphyseal disruptions necessitates accurate reduction and stable fixation of the symphysis – and at times, the posterior pelvic ring – which allows for pain control and early mobilization. Traditionally described methods of fixation include external fixation, subcutaneous INFIX, tension band wiring, and plating [4].

Open reduction with plate fixation through a Pfannenstiel approach is considered the gold standard for management of symphyseal disruption. Several variations among plating constructs exist ranging in size (3.5mm–4.5 mm), length (4 hole–6 hole), type (reconstruction vs dynamic compression), and screw trajectory [5,6]. Percutaneous screw fixation is a well-accepted technique in management of sacral fractures, sacro-iliac disruptions, iliac wing fractures, and fractures of the superior pubic rami. In general, percutaneous techniques offer reduced blood

loss, shorter operative times, smaller incisions, and lower infection risk [10–12]. The aim of percutaneous stabilization of symphysis diastasis is to achieve similar benefits to those realized with percutaneous fixation in other parts of the pelvic ring.

Technique

Preoperative planning

The indications for percutaneous fixation of the pubic symphysis are the same as those for symphyseal plating. However, percutaneous symphysis screw placement is contraindicated in cases where there is symphyseal disruption along with parasymphyseal comminution, as this makes obtaining the entry point impossible. The patient is taken to the operating room as soon as appropriate work-up, management of co-existing injuries, and adequate resuscitation allow.

Patient positioning and draping

The patient is positioned supine on a radiolucent table (Mizunho OSI, Union City, CA) with the arms placed perpendicular to the table on arm extensions. A 2 to 3-inch bump may be placed under the sacrum to facilitate placement of sacroiliac screws for posterior fixation. A foley catheter is placed to decompress the bladder. The patient is prepped and

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draped below the xyphoid process, taking care to remain as posterior as possible along the flanks. The symphysis is palpated, and drapes are placed distal to it. If the need for skeletal traction is anticipated, the corresponding leg is draped free. The C-arm is positioned on the uninjured (or lesser injured) hemipelvis.

Reduction

Several methods for closed or minimally invasive reduction of pubic symphysis diastasis exist. Our strategy for reduction is in general driven by the specific pattern of pelvic ring disruption.

Closed reduction

If placed early, pelvic binders can often restore anatomic or near anatomic alignment to the symphysis (Fig. 1). Cranial or caudal rotational deformity may be corrected using “push-pull” on the legs and correction held by a binder placed below the trochanteric region of the thighs. If fluoroscopy confirms reduction is adequate, percutaneous fixation can proceed.

Percutaneous clamp placement

For some disruptions, reduction can be accomplished with manual pressure on the iliac wings and percutaneous clamp placement or clamp placement alone. A modified pointed symphyseal reduction clamp, with tines placed percutaneously lateral to the pubic tubercles, can be used. To avoid iatrogenic injury to the spermatic cord, our preferred technique is as follows:

- Prior to any incision, the spermatic cord is palpated at the level of the symphysis. The cord is palpable, even in obese patients.
- A stab wound is then made lateral to the spermatic cord
- A joker elevator is used to bluntly develop a path lateral and posterior/deep to the spermatic cord and onto cortical bone just lateral to the pubic tubercle
- Tines of the percutaneous pelvic reduction clamp (Fig. 2) can then be safely placed posterior and lateral to the spermatic cord, and reduction can be assessed with fluoroscopy.

As with closed reduction using a binder, push or pull on the legs can correct rotational deformity, this can be done manually or with skeletal traction.

Pelvic reduction frame

With more complex cases, we use a pelvic reduction frame (Starr Frame, Richardson, TX) to aid and secure reduction. This technique has been described previously [7]. Briefly, the uninjured or lesser injured

hemipelvis is secured to the frame. A ball spike pusher can be placed on the anterior ilium through a percutaneous incision and attached to a motor on the pelvic reduction frame, in this way the unstable hemi-pelvis can be reduced to the intact side (Fig. 3). Schanz pins placed into the LC-2 corridor, may allow for control of internal/external rotation of the ilium, as well as some flexion/extension correction. The Schanz pin may be anchored to the pelvic reduction frame to hold reduction.

Reduction is assessed in standard fashion with multiplanar fluoroscopy.

Cannulated screw placement

Once reduction is achieved, oblique, transverse, or a combination of these pathways may be used (Fig. 4) for screw placement. The femoral pulse is palpated, and the location of the artery is marked on the skin. The spermatic cord is then palpated at the level of the pubic tubercle. A stab incision through the deep dermis is made lateral to the spermatic cord, while ensuring to stay medial to the femoral neurovascular bundle. In obese patients this may be impossible as the guidewire trajectory courses too close to the vessels. A joker elevator (Fig. 6, D) is used to bluntly develop a path to the pubic tubercle.

The ideal start point is on the lateral aspect of the pubic ramus, just lateral to the pubic tubercle and is determined using inlet, outlet, and AP projections (Fig. 5). A 2.4 mm x 450 mm guidewire (Pacific Instruments, Honolulu, HI) is inserted through a custom soft tissue protector (Pacific Instruments; Fig. 6, A and B). A straight or offset device can be used depending on desired trajectory and patient anatomy. The guidewire is advanced towards the outer edge of the contralateral pubic tubercle for parallel screws and an exit point 2 cm below the contralateral pubic tubercle for crossed screws. Frequent inlet, outlet, and AP fluoroscopic views confirm proper trajectory as the guidewire is being placed.

When necessary, wire trajectory can be corrected by replacement of the standard guidewire with a bent, spade-tipped guidewire (Pacific Instruments, Honolulu, HI) on a T-handle chuck and advanced with a mallet (Fig. 5). Once the guidewire is in good position, a depth gauge (Pacific Instruments, Honolulu, HI) over the wire is used to determine screw length. Nested drill sleeves from an intramedullary nail system (Smith and Nephew, Memphis, TN) Fig. 6, C) are placed over the guidewire to protect the surrounding soft tissues. The inner drill sleeve is removed, and a cannulated screw is advanced over the guidewire through the outer drill sleeve. Screw position is confirmed on fluoroscopy (Fig. 7). If a spade-tipped guidewire was used, it is retracted prior to the tip of the screw reaching the bent portion of wire to prevent breakage of the guidewire. With a standard guidewire, the screw can be fully seated and appropriate placement confirmed prior to removing the wire.

When possible, our preference for fixation is two screws in an oblique or transverse configuration, but in small statured patients this is not

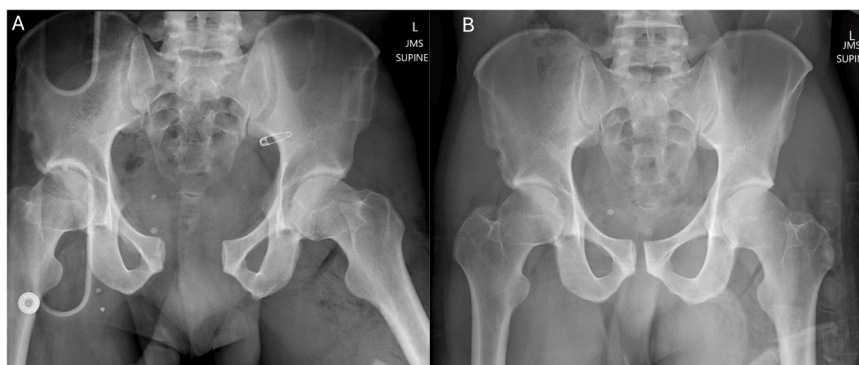


Fig. 1. A- AP pelvis of APC-2 injury. B- AP pelvis immediately following pelvic binder placement.

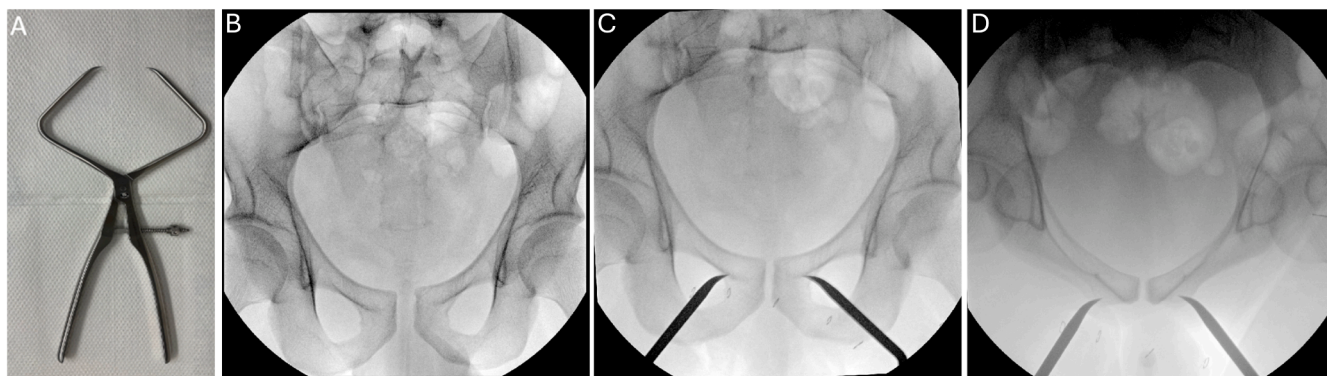


Fig. 2. A- Percutaneous pelvic clamp. B- AP view of an APC-2 injury prior to reduction. C, d- AP and inlet views after reduction with percutaneous pelvic clamp.

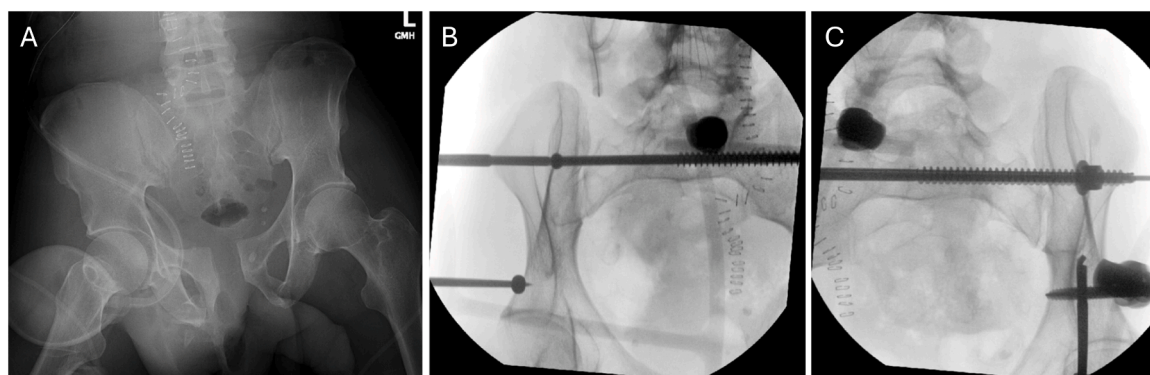


Fig. 3. A- AP view of a right APC-2 injury with SI joint displacement. B- Intra op fluoroscopy demonstrating reduction with ball spike pusher. C- uninjured hemipelvis anchored to frame.

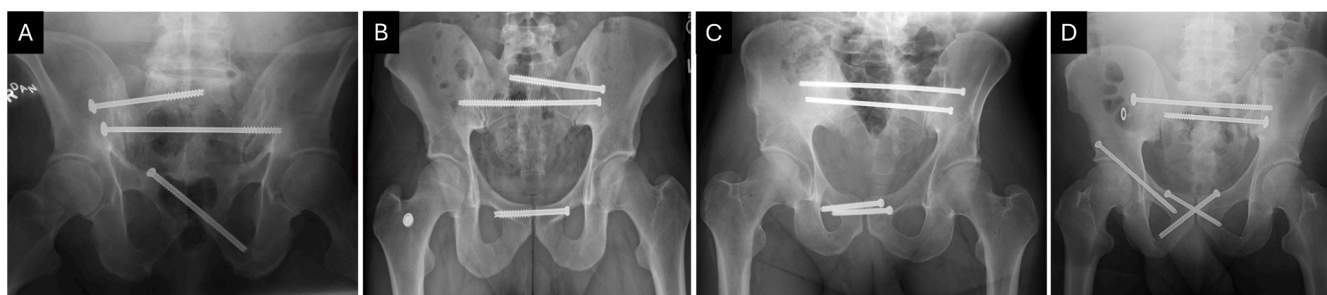


Fig. 4. Example images of oblique (A), transverse (B), parallel (C) and crossed screw (D) configurations.

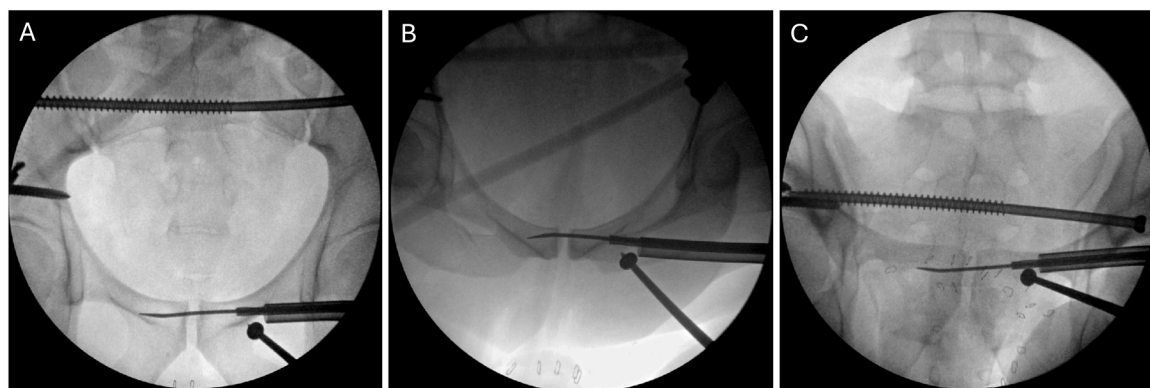


Fig. 5. Ideal start point for the drill on AP (A), inlet (B) and outlet (C) projections; spade tip guidewire was used in this case to direct wire trajectory.

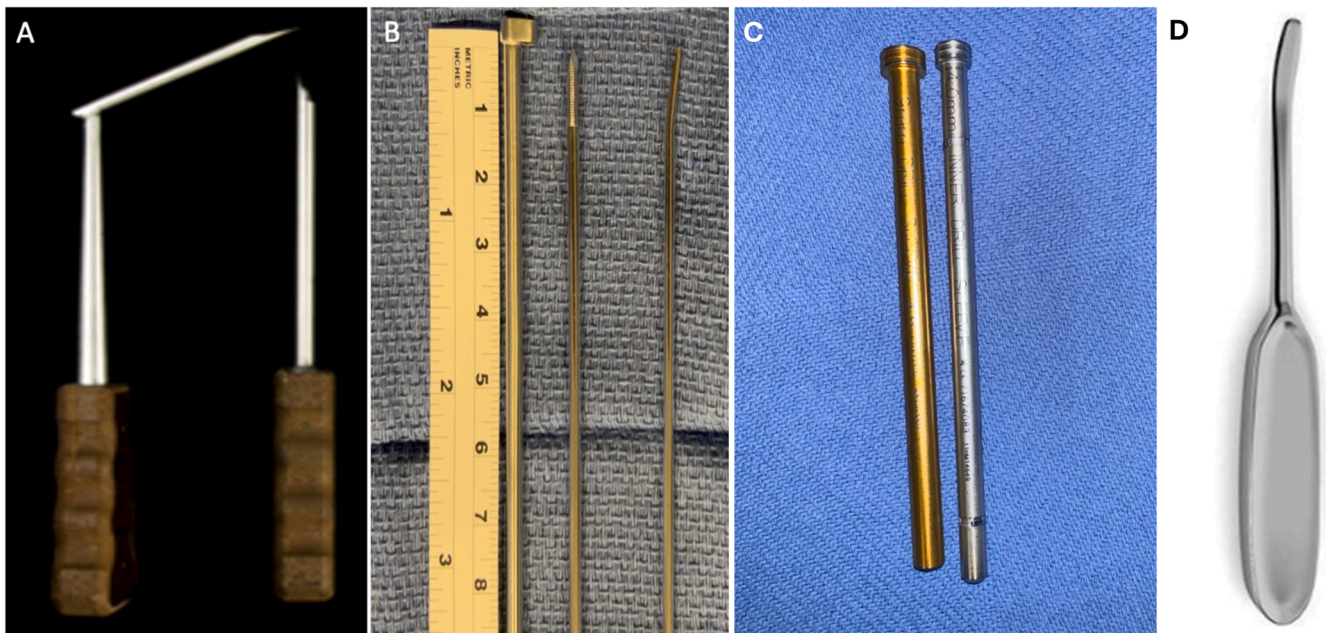


Fig. 6. A. From left to right: offset and straight pigsticker. B. From left to right: Guidewire depth gauge, threaded 2.4 mm x 450 mm guidewire, spade tip guidewire. C. Nested drill sleeves (TRIGEN system, Smith and Nephew, Memphis, TN). D. Joker elevator tool.

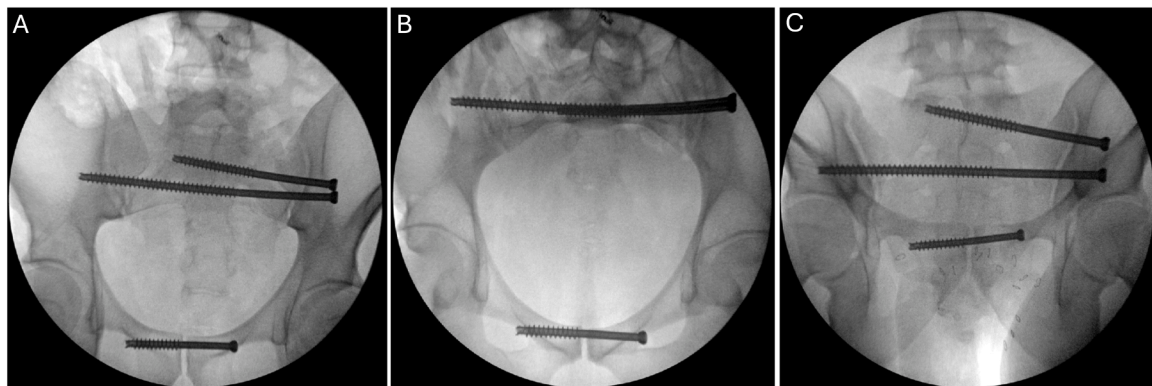


Fig. 7. AP (A), inlet (B), and outlet (C) views demonstrating final screw placement.

always possible.

Percutaneous posterior fixation is also done to improve the strength of the pelvic ring construct.

Postoperative protocol

In unilateral injuries patients are made foot flat weight bearing on the injured side for 12 weeks after surgery and then advanced to weight bearing as tolerated. For bilateral injuries patients are restricted to bed to chair transfers for 12 weeks. The weight bearing protocol may be adjusted based upon concurrent lower extremity injuries and functional status. Unless limited by other injuries, our patients initiate physical therapy on post operative day 1.

Discussion

In this study we describe our preferred surgical technique for percutaneous reduction and fixation of pubic symphysis diastasis. We have employed this technique for ~100 cases over the past 10 years.

Although we commonly use a pelvic reduction frame to reduce symphyseal disruptions, alternative methods of closed reduction have been described [8,9]. The present technique should be avoided in cases

of open injury, bowel/bladder contamination, active infection, and parasymphiseal comminution.

Clinical studies on percutaneous screw fixation of the pubic symphysis have shown favorable results, with implant failure rates, revision surgery rates, and radiographic outcomes similar to traditional open reduction with plate fixation [5,10–12]. Methods to decrease revision rates/implant failure are an ongoing topic of study. Lybrand et al. demonstrated decreased rates of implant failure and revision surgery in patients who underwent symphyseal cartilage excision [13]. While this technique may be successful in select institutions, it is not the standard of care for open pelvic surgery. Further, it is not suited for our described percutaneous technique, which aims to minimize surgical insult. Biomechanical testing has also supported the use of percutaneous screws, with several studies showing either equivalent or superior construct properties compared to plate fixation [1,14–17]. Controversy remains over the definition of “implant failure” and “fixation failure” in the setting of symphyseal disruptions. Furthermore, definitive correlation between the above terms and patient outcomes has yet to be identified. While percutaneous screw fixation of the symphysis yields promising results, it is a relatively new technique, and further studies evaluating patient outcomes should be performed.

For any percutaneous technique, knowledge of the local anatomy is

paramount. Collinge studied the relationship of the spermatic cord and the pubic tubercle in cadaver specimens, highlighting the potential danger of clamp placement directly lateral to the tubercles [18]. However, studies have demonstrated safe corridors for placement of symphyseal screws. Ma et al. confirmed safe bony corridors for the placement of parallel and crossed symphyseal screws in cadaveric specimens [19]. Green et al. reviewed 80 axial computed tomography scans of the abdomen obtained for non-traumatic reasons and defined safe soft tissue corridors between the spermatic cord and femoral neurovascular bundle for instrumentation of the anterior pelvic ring [20].

We recommend direct palpation of the spermatic cord, blunt dissection, as well as use of a specialized reduction clamp and nested drill sleeves to ensure passage of instrumentation and hardware to avoid damage to the cord. Similarly, the femoral neurovascular bundle is at risk and must be kept in mind and protected throughout the procedure. In our center, this technique has been safe and effective. We have not observed any vascular, neurologic, or urologic injuries due to this technique. Clinical and radiologic outcomes have been comparable to those for plate fixation, and no patients have experienced surgical site infection despite a mean BMI of 30.8 in our population. Further, rates of hardware loosening and recurrent diastasis are similar to what we encounter using plate fixation, consistent with reports from China and Spain.

Conclusions

Percutaneous pelvic surgery techniques allow for stable fixation of pelvic ring injuries while minimizing surgical insult to the soft tissue envelope. Percutaneous symphyseal screw fixation is new but promising. In our experience, this technique has proved reliable, efficacious, and safe. We hope the description we've provided will help others who are considering this technique.

Ethics statement

No identifiable information is presented, and all images have been anonymized in accordance with ethical publishing standards. As this is a technical note paper, formal ethics committee approval was not required.

Potential conflicts of interest and funding sources

Adam Starr, MD receives royalties from Starr Frame LLC. For the remaining authors, none are declared.

CRedit authorship contribution statement

Joshua J Sun: Writing – review & editing, Writing – original draft. **Peter Cannamela:** Writing – review & editing. **John L Eakin:** Conceptualization. **Ishvinder Grewal:** Supervision, Methodology. **Ashoke K Sathy:** Supervision. **Adam J Starr:** Writing – review & editing, Visualization, Validation, Supervision, Methodology.

Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests

Adam Starr reports a relationship with Starr Frame LLC that includes: equity or stocks. If there are other authors, they declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

References

- [1] Zheng YQ, Chen LL, Shen JZ, et al. Biomechanical evaluation of seven fixation methods to treat pubic symphysis diastasis using finite element analysis. *J Orthop Surg Res* 2022;17:189.
- [2] Young JW, Burgess AR, Brumback RJ, et al. Pelvic fractures: value of plain radiography in early assessment and management. *Radiology* 1986;160:445–51.
- [3] Benders KEM, Leenen LPH. Management of hemodynamically unstable pelvic ring fractures. *Front Surg* 2020;7:601321.
- [4] Gill JR, Murphy C, Quansah B, et al. Management of the open book APC II pelvis: survey results from pelvic and acetabular surgeons in the United Kingdom. *J Orthop* 2017;14:530–6.
- [5] Kitridis D, Tsikopoulos K, Givissis P, et al. Percutaneous fixation for traumatic symphysis pubis disruption—are the results superior compared to open techniques? A systematic review and meta-analysis of clinical and biomechanical outcomes. *J Clin Med* 2023;12.
- [6] Rojas C, Ewertz E, Hormazabal JM. Fixation failure in patients with traumatic diastasis of pubic symphysis: impact of loss of reduction on early functional outcomes. *J Orthop Surg Res* 2021;16:661.
- [7] Lefaivre KA, Starr AJ, Reinert CM. Reduction of displaced pelvic ring disruptions using a pelvic reduction frame. *J Orthop Trauma* 2009;23:299–308.
- [8] Shen L, Xue X, Ping Y, et al. Evolution of the reduction technique for unstable pelvic ring fractures: a narrative review. *Eur J Med Res* 2025;30:335.
- [9] David G, Tucker NJ, Marc C, et al. Percutaneous pelvic ring fracture reduction using an external fixator: a technical trick and case series. *Int Orthop* 2025;49:1739–46.
- [10] Mu WD, Wang H, Zhou DS, et al. Computer navigated percutaneous screw fixation for traumatic pubic symphysis diastasis of unstable pelvic ring injuries. *Chin Med J (Engl)* 2009;122:1699–703.
- [11] Chen L, Zhang G, Song D, et al. A comparison of percutaneous reduction and screw fixation versus open reduction and plate fixation of traumatic symphysis pubis diastasis. *Arch Orthop Trauma Surg* 2012;132:265–70.
- [12] Eakin JL, Grewal IS, Fene ES, et al. Percutaneous screw fixation of pubic symphysis disruption: a preliminary report. *J Clin Orthop Trauma* 2022;26:101806.
- [13] Lybrand K, Kurylo J, Gross J, et al. Does removal of the symphyseal cartilage in symphyseal dislocations have any effect on final alignment and implant failure? *J Orthop Trauma* 2015;29:470–4.
- [14] O'Neill DE, Bradley HR, Hull B, et al. Percutaneous screw fixation of the pubic symphysis versus plate osteosynthesis: a biomechanical study. *OTA Int* 2022;5:e215.
- [15] Yao F, He Y, Qian H, et al. Comparison of biomechanical characteristics and pelvic ring stability using different fixation methods to treat pubic symphysis diastasis: a finite element study. *Medicine* 2015;94:e2207.
- [16] Cano-Luis P, Giraldez-Sanchez MA, Martinez-Reina J, et al. Biomechanical analysis of a new minimally invasive system for osteosynthesis of pubis symphysis disruption. *Injury* 2012;43(Suppl 2):S20–7.
- [17] Lazaro Gonzalez A, Martinez Reina J, Cano Luis P, et al. Is cannulated-screw fixation an alternative to plate osteosynthesis in open book fractures? A biomechanical analysis. *Injury* 2016;47(Suppl 3):S72–7.
- [18] Collinge CA, Beltran MJ. Anatomic relationship between the spermatic cord and the pubic tubercle: are our clamps injuring the cord during symphyseal repair? *J Orthop Trauma* 2015;29:290–4.
- [19] Ma K, Zhu L, Fang Y. A preliminary anatomical study on design of cannulated screw channels for fixation of symphysis pubis diastasis in small samples]. *Zhongguo Xiu Fu Chong Jian Wai Ke Za Zhi* 2014;28:43–6.
- [20] Green A, Feldman G, Moore DS, et al. Identifying safe corridors for anterior pelvic percutaneous instrumentation using computed tomography-based anatomical relationships. *Injury* 2022;53:3390–3.