Technical Note

# Stemless Total Shoulder Arthroplasty With Orthobiologic Augmentation

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**Abstract:** Total shoulder arthroplasty (TSA) has evolved over the years and is used for a variety of indications, with arthritis being the most common. Stemless TSA is a unique bone-preserving design that can eliminate rotational malalignment. Additionally, recent literature has found utility in the use of biological mesh and a platelet-rich plasma injection to improve healing. The purpose of this article is to outline the process of TSA using a stemless system and how to incorporate the use of amnion matrix and platelet-rich plasma into the surgical technique.

Total shoulder arthroplasty (TSA) is an increasingly performed surgical technique used to restore function and reduce pain when the glenohumeral joint is compromised.[1-3] Common indications for shoulder replacement include osteoarthritis (OA), inflammatory arthritis, and proximal humeral fractures.[4] These pathologies can cause reduced joint mobility, persistent pain, and weakness. In 2008, OA was the primary diagnosis for 77% of TSAs performed in the United States.[5] Population-based studies suggest that 16.1% to 20.1% of adults older than 65 years have radiographic evidence of glenohumeral OA.[6]

The gold standard of treatment for end-stage glenohumeral OA has been the TSA, with some populations reaching a 10-year implant survival rate of 96%.[7,8] TSAs have typically consisted of a humeral stem, a prosthetic head, and a glenoid component.[9] Advancement in the design has changed the components from constrained designs to more anatomic designs.[9,10] Although traditional stemmed implants have been studied extensively and have shown good outcomes, they face challenges regarding humeral bone loss and the difficult treatment of periprosthetic fractures and cases of revision surgery.[11-13] Stemless shoulder replacements have been shown to accurately represent the humeral head position independent of the humeral shaft orientation.[13-15] This allows for the center of rotation, inclination, retroversion, and offset to be accurately re-created.[13,15,16] In addition to fewer intraoperative complications, stemless designs preserve the humeral bone stock, which facilitates the treatment of periprosthetic fractures and cases of revision surgery.[11,12,15,17-19]

Despite improvements in implant design, stemless TSAs do not change the surgical approach and still require the detachment of the subscapularis tendon. Failure of the subscapularis repair is an important source of post-arthroplasty complications.[20-24] The tendon requires repair during surgery, which is limited by surgical fixation and at risk of complications such as repair failure, tearing, anterior instability, glenoid loosening, and polyethylene wear.[25-27] The use of platelet-rich plasma (PRP) and amnion matrix for rotator cuff repairs could improve outcomes by promoting healing.[28] The use of orthobiologics may be applicable to the subscapularis closure after TSA. The purpose of this article is to describe a technique for a stemless TSA with the use of a biological

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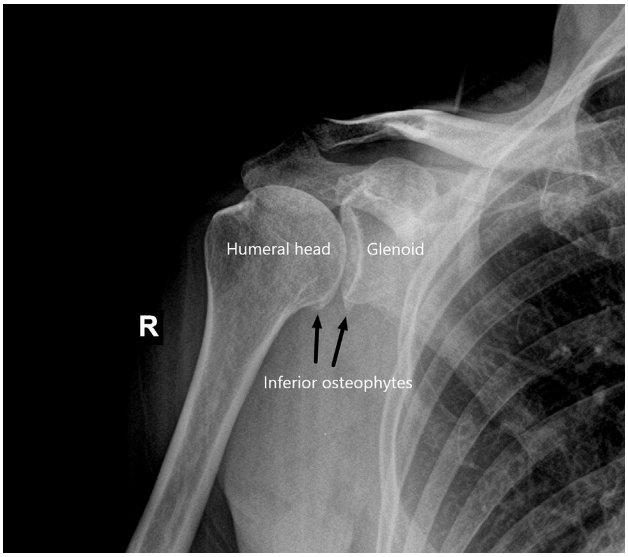


**Fig 1.** Preoperative standing radiograph (anteroposterior view) of the right (R) shoulder showing signs of glenohumeral arthritis after arthroscopic debridement. Notable bone spurring is apparent with inferior osteophyte formation. Owing to the patient's young age and good bone density, the patient is a candidate for stemless arthroplasty.

membrane and PRP to facilitate the healing process (Video 1).

## Surgical Technique

### Preoperative Considerations

Preoperative assessment consists of a physical examination and radiographs to identify the degree of OA (Fig 1). The patient is placed in the beach-chair position and anesthetized with general anesthesia. All bony prominences are well padded, and the neck is well positioned. The operative shoulder is treated with skin preparation solution and then draped in sterile fashion. An arm holder is used for positioning.

### Surgical Approach to Glenohumeral Joint

A curvilinear incision is started at the border of the midsection of the clavicle and proceeds down the arm following the deltopectoral groove. Blunt dissection is performed, and the cephalic vein is mobilized away from the interval. Once the interval is achieved, a deep Kolbel retractor is used to expose the biceps tendon and subscapularis. No. 2 FiberWire (Arthrex, Naples, FL) is used to tag the subscapularis tendon. The subscapularis is then released and retracted. The joint capsule is incised, the humeral head is subluxated, and the arm is rotated externally for maximum exposure.

### Humeral Head Resection

A rongeur is used to excise osteophytes to view the native contour of the humeral head and neck. The humerus is dislocated anteriorly with a large Darrach retractor to expose the head. A freehand cut of the anatomic head is made using a sagittal saw at the anatomic neck, with care taken to protect the rotator cuff with the Darrach retractor (Fig 2).

### Trunnion Preparation

The humeral head implant is sized using the native head resection. The trunnion guide is then compared with the humerus and fixed into the bone by advancing the pegs (Fig 3). Reaming is performed by hand using a core reamer to create the implantation site (Fig 4). The

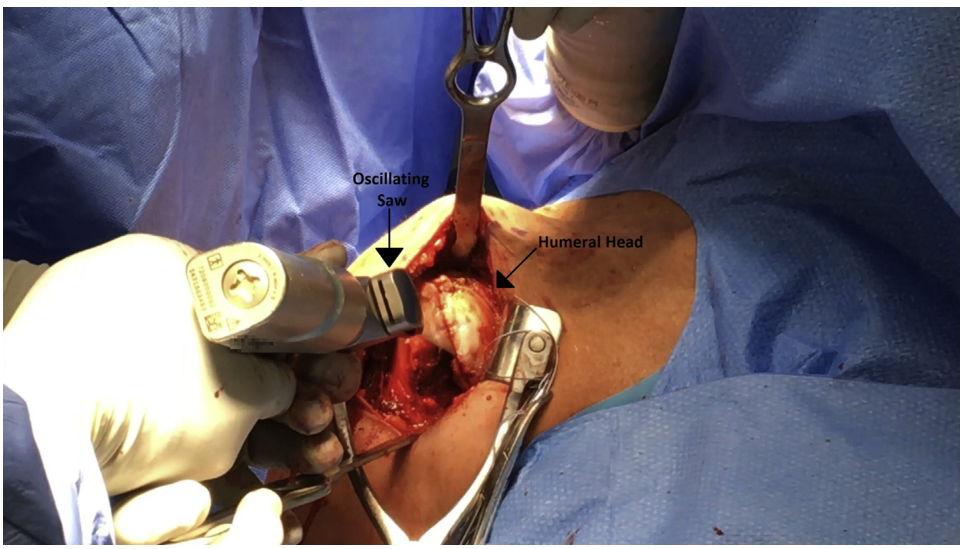


**Fig 2.** Intraoperative image of the right shoulder taken from anterior to posterior showing humeral head resection. The patient is placed in the beach-chair position with the right shoulder draped into the surgical field. A freehand cut of the anatomic head is made using a sagittal saw at the anatomic neck, with care taken to protect the rotator cuff by using Darrach retractors. A guide is available depending on surgeon preference.

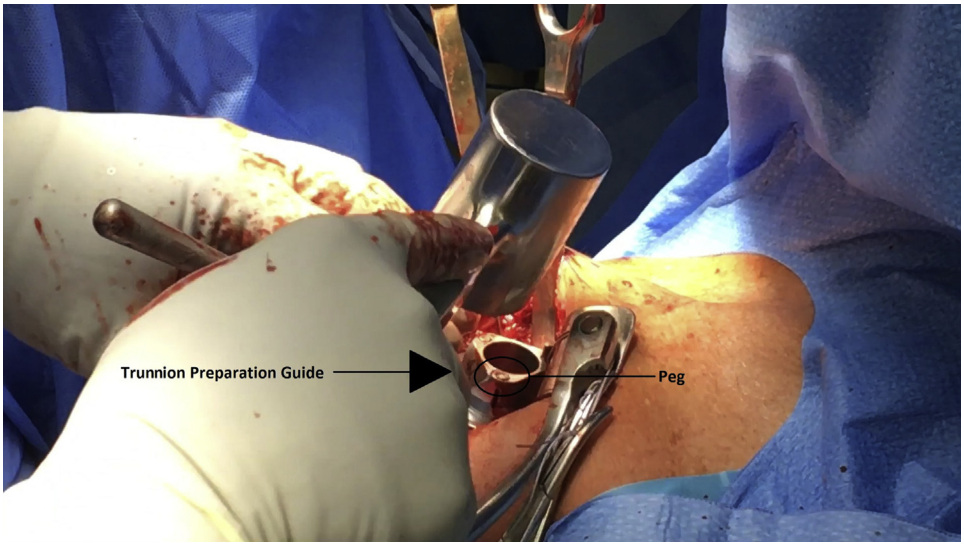


**Fig 3.** Intraoperative image of the right shoulder taken from anterior to posterior showing fixation of the trunnion guide into the bone by advancing the pegs. The patient is placed in the beach-chair position with the right shoulder draped into the surgical field. The appropriately sized trunnion guide is placed over the resected humerus and fixed in place by the pegs.

guide is then removed, and a protective cap is placed on the humeral head.

## Glenoid Arthroplasty

A Kolbel retractor is placed to expose the glenoid. The labrum is excised to expose the cortical rim. By use of a pin guide, a guidewire is advanced centrally into the glenoid. A semicircular reamer is used to denude the cartilage, followed by use of a 6-mm drill to make the center hole. A glenoid drill guide is placed over the glenoid and secured with the drill through the superior hole. The inferior keel is reamed and then expanded using a broach. After irrigation, simple cement is introduced into the glenoid fossa. The glenoid component (Arthrex Univers Vaultlock) is then impacted.

## Humeral Head Replacement

The protective cap is removed, and the trunnion guide is replaced. The centering drill guide is then fully seated into the trunnion guide. A drill center guide pin with laser lines is advanced to the lateral cortex without breaching it. The pin is used to measure the depth of the trunnion, so care must be taken not to breach the lateral cortex (Fig 5). After the size is determined, the guide and template are removed.

The trunnion implant is placed over the drill guide. This implant is impacted into place with the handle placed over the guide. The guide is removed, and the cage screw is placed in the trunnion and advanced using a screwdriver inserted through the impactor handle (Fig 6).

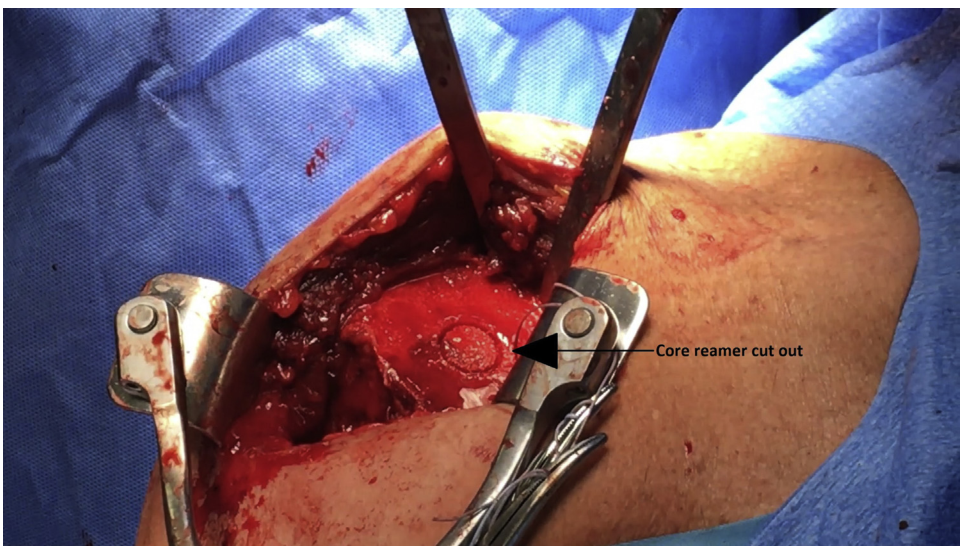


**Fig 4.** Intraoperative image of the right shoulder taken from anterior to posterior showing the core reamer canal reamed by hand to create the implantation site. The patient is placed in the beach-chair position with the right shoulder draped into the surgical field. The canal will provide a seat for the trunnion implant.

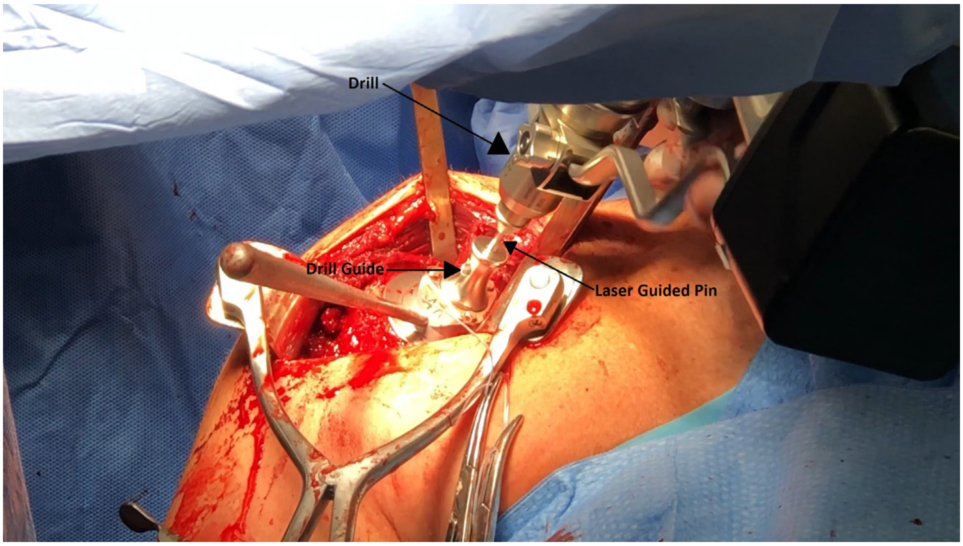


**Fig 5.** Intraoperative image of the right shoulder taken from anterior to posterior showing a drill center guide pin used to measure the depth of the trunnion cage screw. The patient is placed in the beach-chair position with the right shoulder draped into the surgical field. The drill guide has measurements to allow for proper depth sizing of the cage screw.

The humeral head implant (Arthrex Eclipse) is then placed on the trunnion, impacted, and checked (Fig 7). The shoulder is reduced and taken through the motion arc with 40° of external rotation and 60° of internal rotation. There should be roughly 50% posterior translation. The joint is then copiously irrigated.

### Subscapularis Repair and Orthobiologic Augmentation

The rotator cuff interval is closed and the subscapularis is repaired in a side-to-side fashion with No. 2 FiberWire sutures. An amnion matrix (Arthrex) is then applied over the subscapularis repair and fixed using No. 0 Vicryl sutures (Ethicon, Somerville, NJ) with the epithelial layer facing up (Figs 8 and 9). Prior to implantation, 40 mL of the patient's blood is drawn and centrifuged down for a PRP injection. Ten milliliters of PRP is injected into the amnion matrix as well as intra-articularly (Fig 10). The deltopectoral interval is closed using Vicryl. The subcutaneous tissue and skin are closed. Follow-up imaging shows intact hardware with bone infiltration (Fig 11). Table 1 shows pearls and pitfalls related to the procedure.

## Discussion

The demand for shoulder arthroplasty is projected to increase by 8.2% per year in patients younger than

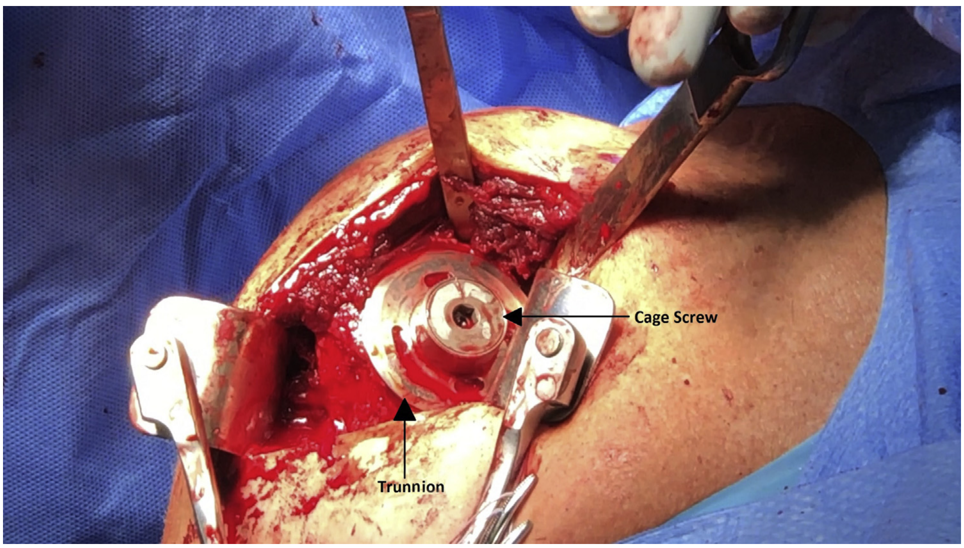


**Fig 6.** Intraoperative image of the right shoulder taken from anterior to posterior showing the cage screw placed in the trunnion and advanced using a screwdriver inserted through the impactor handle. The patient is placed in the beach-chair position with the right shoulder draped into the surgical field. The cage screw will hold the trunnion and implant in place.

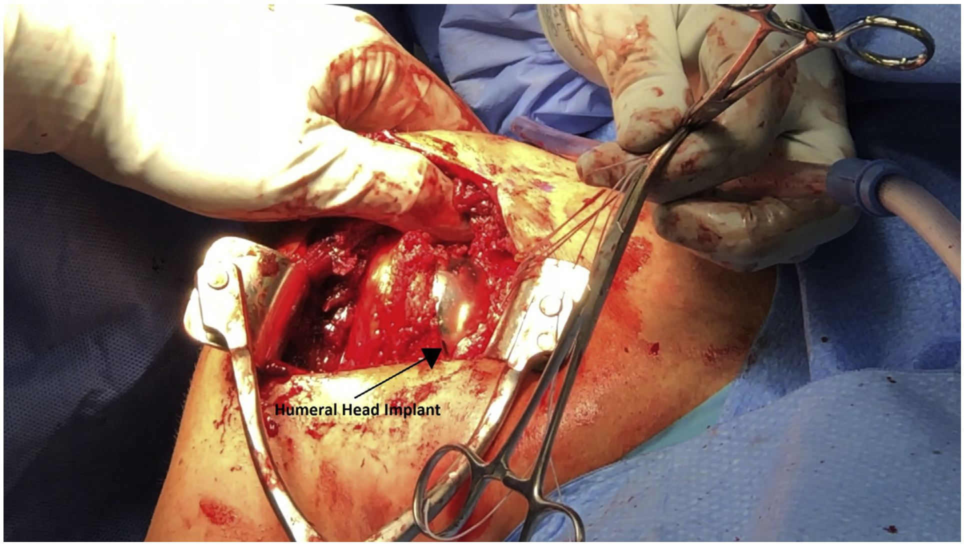


**Fig 7.** Intraoperative image of the right shoulder taken from anterior to posterior showing the humeral head implant (Arthrex) after being placed on the trunnion and impacted. The patient is placed in the beach-chair position with the right shoulder draped into the surgical field. Once the implant is impacted into place, the shoulder is taken through the range-of-motion arc.

55 years; this rise indicates a need for TSAs with better outcomes for younger, active patients that can easily undergo revision.[29] The stemless implant has secure bony fixation and ingrowth, avoids stem-related complications, and decreases blood loss and the operative time.[13,30,31] In patients with post-traumatic OA, stemless TSAs are also useful because they can better accommodate operative hardware that would normally obstruct a conventional stem.[32] The main disadvantage of stemless TSAs is the need for good humeral bone density, limiting its use in elderly patients.[32] Table 2 lists advantages and disadvantages of the proposed technique.

The proposed technique (Video 1) uses a stemless prosthesis and orthobiologic augmentation to hasten TSA recovery. An amnion matrix is used to promote healing of the subscapularis tendon. Postoperative subscapularis failure, which has an incidence rate of approximately 3%,[26] has been associated with anterior instability and subluxation of the humeral head, as well as the need for additional surgery.[33] Incorporation of amnion promotes healing in partial rotator cuff tears and may be applicable to subscapularis repair.[28,34] Although relatively few clinical data are available, amnion matrices have been shown to improve the outcomes of supraspinatus tears in a

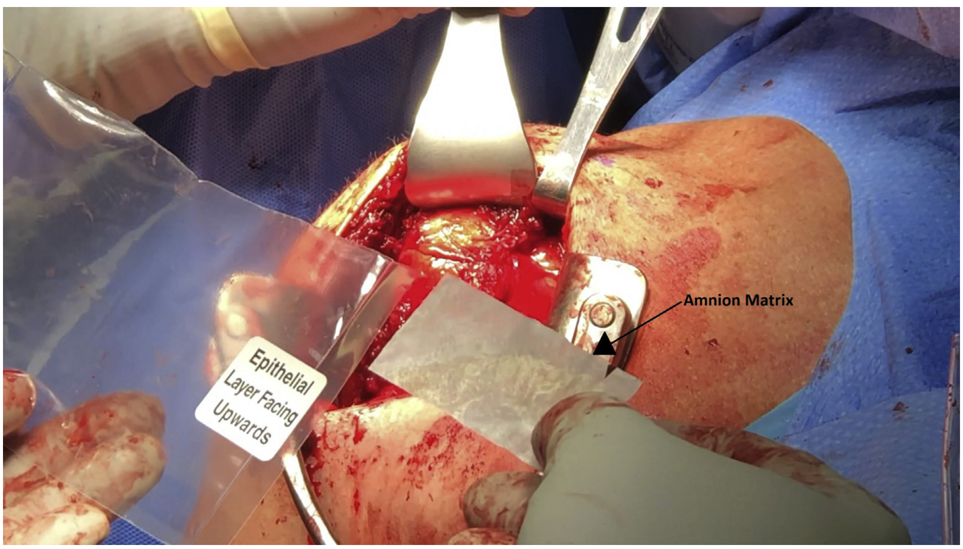


**Fig 8.** Intraoperative image of the right shoulder taken from anterior to posterior showing the amnion matrix (Arthrex) before being applied over the subscapularis repair. The patient is placed in the beach-chair position with the right shoulder draped into the surgical field. The subscapularis repair is performed with No. 2 FiberWire in a side-to-side fashion.

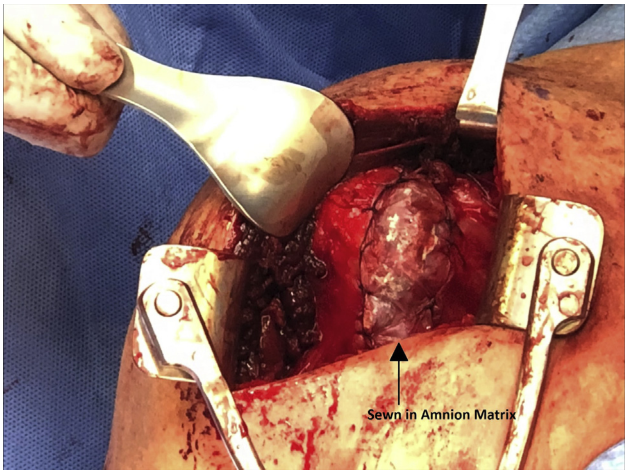


**Fig 9.** Intraoperative image of the right shoulder taken from anterior to posterior showing the amnion matrix (Arthrex) after application over the subscapularis repair. The patient is placed in the beach-chair position with the right shoulder draped into the surgical field. The amnion matrix is fixed using No. 0 Vicryl sutures with the epithelial layer facing up.

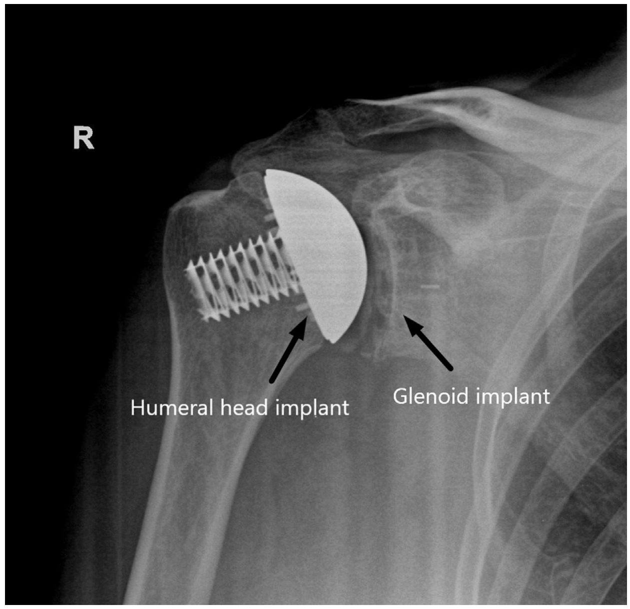


**Fig 11.** Postoperative follow-up radiograph (anteroposterior view) of the right (R) shoulder showing the intact stemless humerus implant and glenoid component with bony incorporation and without loosening.

canine model.[35] More generally, amnion matrices can facilitate tendon healing and may result in a quicker recovery.[36]

Our technique used PRP to further promote healing of the subscapularis and surrounding tissues. Application of PRP to a recently repaired rotator cuff tendon has been shown to increase the vascularity of the tendon in the early stages of healing.[37] Despite mixed evidence, several studies have indicated that PRP reduces pain and blood loss and improves short-term outcomes of arthroplasty.[38-41] Although the use of PRP injections during TSA has not been well studied, the relative safety and the evidence of PRP's positive effect on soft-tissue healing make the use of PRP a prudent decision to optimize TSA outcomes.

In conclusion, the use of the stemless system along with biological agents likely produces an optimal outcome for patients with adequate humeral bone stock and those wishing to return to active lifestyles. When compared with traditional stemmed arthroplasty, the proposed method preserves more of the original anatomy, spares potential operative complications, and offers flexibility for revision. Orthobiologic augmentation potentially provides repair optimization with few risks. Longitudinal studies are required to determine more accurate life span estimates.

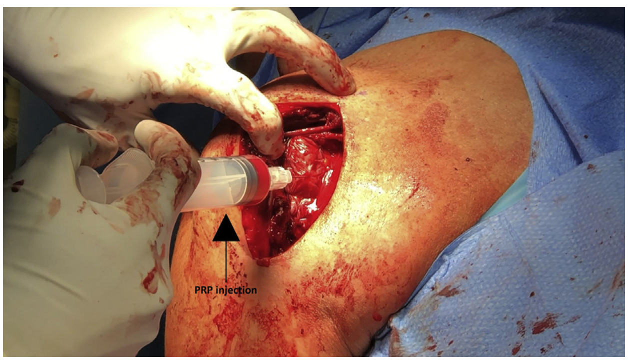


**Fig 10.** Intraoperative image of the right shoulder taken from anterior to posterior showing platelet-rich plasma (PRP) injection into the amnion matrix and intra-articular space. The patient is placed in the beach-chair position with the right shoulder draped into the surgical field. The PRP injection and amnion matrix support healing of the subscapularis repair.

**Table 1.** Pearls and Pitfalls of Stemless Arthroplasty System and Orthobiologic Augmentation

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| Pearls |
| Size the trunnion so that it covers the cortical bone. |
| Perform freehand cutting of the humeral head to match the native joint anatomy. |
| Use the impactor handle to hold the trunnion in place to prevent angling or rotation while advancing the cage screw. |
| Pitfalls |
| Avoid placing the amnion matrix with the epithelial layer down. |
| Avoid sizing the trunnion using the osteophytes. |
| Avoid drilling through cortical bone when measuring the cage screw. |
| Avoid oversizing the cage screw by using the last size passed by the guide pin into the drill guide. |

**Table 2.** Advantages and Disadvantages of Stemless Arthroplasty System and Orthobiologic Augmentation

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| Advantages |
| Biologics promote healing of the rotator interval. |
| An anatomic design is used, with no rotational component associated with a stem. |
| Revision, if necessary, does not require stem removal. |
| The humeral bone stock is maintained. |
| The technique is compatible with existing hardware for post-traumatic osteoarthritis. |
| The operative time is shorter and there is less operative blood less compared with stemmed implants. |
| Disadvantages |
| Amnion matrix is expensive. |
| Good bone density is required. |
| Proximal humeral fractures are not amenable to stemless designs. |

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