

Host Bone-Baseplate Ingrowth Contact Determines Baseplate Survivorship

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INTRODUCTION: Host bone ingrowth into the baseplate of a reverse shoulder arthroplasty (RSA) is a prerequisite for a successful surgical outcome. Yet, it is unclear what factors determine baseplate survivorship. The study's goals are to identify factors that are associated with glenoid base plate loosening. Our hypothesis is that long term implant stability is influenced by host bone-baseplate ingrowth contact.

METHODS:

This is an IRB approved retrospective review of a single surgeon's practice from 5/2014 to 10/2016 using a one-piece screw in baseplate (Fig. 1A). The study's inclusion criteria were: 1) AequalisTM Rev II baseplate (Tournier, MN, USA) with only two locking screws, 2) primary RSA, 3) greater than one-year of follow up, and 4) single surgeon. Exclusion criteria was postoperative baseplate loosening with positive cultures, indicating infection. The AequalisTM Rev II screw was designed with plasma spray coating, ingrowth, on its backside, one-piece central post which combines 10mm of proximal ingrowth with a tapered 9.5mm diameter threaded screw, and 2mm of lateral offset (Fig. 1A arrowhead shows junction between post ingrowth and screw). The BIO-RSA technique was used in some cases to restore the glenoid version and joint line.

Chart review determined age, sex, diagnosis, humeral implant offset, use of bone graft, baseplate loosening, revision surgery, and intraoperative tissue cultures. Preoperative radiographs, CTs, and MRIs were used to determine diagnosis, intermediate version, and humeral head migration. Postoperative radiographs were examined to measure amount of host bone-baseplate ingrowth contact, implant tilt, and base plate loosening. Amount of host bone-baseplate ingrowth contact was grouped into ≥ 5 mm (Fig. 1B), < 5 mm (Fig. 1C), and no contact (Fig. 1D) between the host bone and the plasma spray baseplate. Loosening was defined as change in component position or screw breakage (Fig. 2). Stable versus unstable baseplate data was statistically compared to determine factors associated with survivorship. Significance was set at $p < 0.05$.

RESULTS:

Fifty-eight patients met the inclusion criteria, and one patient was excluded because of positive cultures during revision surgery. There were 57 patients in this study 36 women (63%). The mean age at surgery was 70 ± 9 years and mean follow up was 39 ± 25 months. The BIO-RSA technique was used in 47 patients (83%) and postoperative radiographs showed that all grafts incorporated into native bone without substantial absorption. Loosening was seen in 10 patients (17.5%) and the average time to loosening was 26 ± 19 months (range 6-57 months). Peripheral screw breakage occurred in 9/10 (90%) at the junction between the native bone and the graft (Fig. 2B). Baseplate shift without screw break happened in one patient (Fig. 2D).

Host bone-ingrowth baseplate contact was ≥ 5 mm in 13 (23%), < 5 mm in 6 (10%), no contact in 38 (67%). Loosening occurred in 10 patients (18%; 10/57). All 10 patients with loosening underwent successful revision RSA; the intraoperative tissue cultures were negative for bacterial growth. Notice, all cases of loosening occurred in patients with no contact between the host bone and the plasma spray baseplate ingrowth (Table 1).

Baseplate loosening was significantly ($p = 0.048$) associated with no contact between the host bone and the baseplate ingrowth. Sex, diagnosis, preoperative humeral head location, glenoid version, glenosphere lateralization, baseplate tilt and BIO-RSA were not associated with loosening ($p \geq 0.095$).

Revision surgery to RSA was performed in 11/57 (21%) patients: 10 for glenoid loosening and 1 for humeral loosening. One patient underwent heterotopic bone resection for pain and stiffness 13 months after the RSA.

DISCUSSION AND CONCLUSION:

Glenoid baseplate loosening was significantly ($p = 0.48$) associated with no host bone-baseplate ingrowth contact. All implants were initially well fixed to host bone with a one piece 9.5mm center screw and two 5.0mm locking screws. However, after 39 ± 25 months baseplate loosening occurred in 26% (10/38) when the humeral head bone graft was > 10 mm thick, which resulted in no contact between the host bone and the baseplate's plasma spray ingrowth. Surprisingly, 74% (28/38) with no contact did not have loosening. Baseplate survival was 100% when host bone-baseplate ingrowth was ≥ 5 mm. In cases with substantial glenoid bone loss, it is recommended that 5 to 15mm of contact is needed between the host bone and the ingrowth center post for long term stability. The study's findings support the above recommendation.

The failure mode of 9/10 patients with loosening were similar: a wiper blade central screw and broken locking screws at host-graft junction, despite near complete incorporation of the bone graft (Fig. 2B). This observation strongly suggests that the humeral head autograft was weaker in compression than host bone and does not consistently integrate into the ingrowth, plasma spray, section on the implant. These two above findings implies that metal wedges or custom implants may be more structurally sound than bone grafting for large uncontained glenoid defects

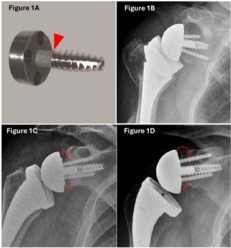


Figure 1 A-D: 1A) AequalisTM Rev II glenoid base plate, arrowhead shows junction between post ingrowth and screw. 1B) Radiograph illustrating ≥ 5 mm host bone-baseplate ingrowth contact. 1C) < 5 mm host bone-baseplate ingrowth contact or more contact between Bio and host bone, and 1D) No contact between host bone and baseplate ingrowth.

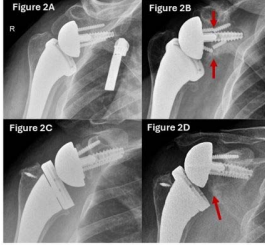


Figure 2A-D: Loosening is defined as a broken screw and/or shift of the baseplate. 2A) Notice no contact between baseplate ingrowth and host bone. 6 month radiograph. 2B) Loosening of the implant shown in Figure 2A at 26 months after surgery. 2C) Different patient than 2A with no contact between baseplate ingrowth. 4 month radiograph, and 2D) Loosening of implant illustrated in 2C at 54 months following surgery.

Table 1. Amount of Initial Ingrowth Contact vs. Stability		
Host bone-baseplate ingrowth contact	No loosening	Loosening
≥ 5 mm	13 (100%)	0
< 5 mm	6 (100%)	0
No contact	28 (74%)	10 (26%)