Custom knee implants and patient-specific instrumentation (PSI) have been developed as alternatives to off-the-shelf implants and conventional cutting guides for joint arthroplasty. Custom implants and patient-specific cutting guides are constructed with the aid of preoperative 3-dimensional computed tomography (CT) or magnetic resonance imaging (MRI) scans and proprietary planning software. The goals of custom implants and patient-specific cutting guides are to increase surgical efficiency and to improve implant alignment and clinical outcomes.

**Related Policies**

- N/A

**Policy**

Use of custom implants or patient-specific instrumentation (e.g., cutting guides) for joint arthroplasty, including but not limited to use in unicompartmental or total knee arthroplasty, is considered **investigational**.

**Policy Guidelines**

There are no specific codes for these implants and instrumentation. The joint arthroplasty procedure would be reported using the regular CPT codes for that surgery.

The preplanning for the surgery may involve magnetic resonance (MRI) or CT imaging which may help to identify these procedures.

**Benefit Application**

Benefit determinations should be based in all cases on the applicable contract language. To the extent there are any conflicts between these guidelines and the contract language, the contract language will control. Please refer to the member’s contract benefits in effect at the time of service to determine coverage or non-coverage of these services as it applies to an individual member.

Some state or federal mandates (e.g., Federal Employee Program (FEP)) prohibit Plans from denying Food and Drug Administration (FDA) - approved technologies as investigational. In these instances, plans may have to consider the coverage eligibility of FDA-approved technologies on the basis of medical necessity alone.
Rationale

Background

TKA (also called knee replacement) and unicompartmental knee arthroplasty (UKA) are an established treatment for relief of significant, disabling pain caused by advanced arthritis. TKA is considered among the most successful medical procedures in the United States in terms of the degree of improvement in functional status and quality of life. It is projected that by 2030, the demand for knee replacement will approach 3.5 million procedures.¹

TKA and UKA are performed by removing the damaged cartilage surface and a portion of underlying bone using a saw guided by templates and jigs. The removed cartilage and bone from the distal femur and proximal tibia are replaced with implants that recreate the surface of the joint. Patellar resurfacing may also be performed. Three-dimensional implant alignment (coronal, sagittal, axial) is considered to be critical for joint articulation and implant longevity. Generally, less than 3° deviation from the rotational or mechanical axis, as determined by a straight line through the center of the hip, knee, and ankle on the coronal plane, is believed to minimize the risk of implant wear, loosening, instability, and pain.

The placement of conventional cutting guides (templates and jigs) is based on anatomic landmarks or computer navigation (see policy No. 7.01.96). Use of conventional instrumentation has been shown to result in malalignment of approximately one third of implants in the coronal plane.² Computer-assisted navigation can significantly reduce the proportion of malaligned implants compared with conventional instrumentation but has a number of limitations including a lack of rotational alignment, increased surgical time, and a long learning curve. In addition, no studies have demonstrated an improvement in clinical outcomes with computer-assisted navigation compared with conventional instrumentation.

Custom implants and PSI have been developed as an alternative to off-the-shelf implants and conventional cutting guides with the goal of improving both alignment and surgical efficiency. A number of patient-specific cutting guides and a lesser number of custom implants (with their associated cutting guides) are currently being marketed (see Regulatory Status next). Custom implants and patient-specific guides are constructed with the use of preoperative 3-dimensional CT or MRI scans which are taken about 4 to 6 weeks before the surgery. The images are sent to the planner/manufacturer to create a 3-dimensional model of the knee and proposed implant. After the surgeon reviews the model of the bone and implants, makes adjustments, and approves the surgical plan, the manufacturer fabricates the custom knee implants and/or disposable cutting guides.

The proposed benefits of using patient-specific implants and instrumentation during TKA include improved alignment, decreased operative time, increased patient throughput, fewer instrument trays, reduced risk of fat embolism and intraoperative bleeding (no intramedullary canal reaming), shorter recovery, reduced postoperative pain, reduced revision rate, and reduced costs. However, the nonsurgical costs of the procedure may be increased due to the requirement for preoperative CT or MRI, preoperative review of the template, and fabrication of the PSI. In addition, the patient-specific template relies on the same anatomic landmarks as conventional TKA and does not take soft tissue balancing into account. Thus, reliability of the cutting guides and the need for
Medical Policy

intraoperative changes such as conversion to conventional instrumentation are also important outcomes.

**Regulatory Status**

There are a number of patient-specific cutting block systems and custom knee implants that have been cleared for marketing by FDA. An example of one device description is single-use, disposable cutting guides designed and manufactured from patient imaging data (MRI/CT). The cutting guides are used to aid the surgeon intraoperatively in making the initial distal femoral and the initial proximal tibial bone cuts during a TKA surgery. The cutting guides also establish the references for component orientations. Planning systems (e.g., from Materialise N.V.) for the personalized instruments have also received FDA 510(k) marketing clearance.

The Smith & Nephew Patient Matched Instrumentation (now called Visionaire™ Patient Matched Instrumentation) was the first to receive FDA clearance for marketing of patient-specific cutting guides in 2008. Other patient-specific cutting guide systems that are cleared for marketing include:

**MyKnee® Patient Matched Cutting Blocks (Medacta)**
- Signature™ Planner/Signature Guides (Materialise N.V., and Biomet),
- ShapeMatch® Cutting Guide (Stryker)
- TruMatch® Personalized Solutions (DePuy Orthopaedics)
- Prophecy™ Pre-operative Navigation Alignment Guides (Wright Medical Technology)
- Zimmer® Patient Specific Instruments and Zimmer® Patient Specific Instruments Planner (Materialise N.V. and Zimmer)

Custom knee implants with their associated patient-specific cutting guides (iJig® instrumentation, ConforMIS) include:
- ConforMIS iTotal® Cruciate Retaining Knee Replacement System (ConforMIS)
- ConforMIS iTotal® Posterior Stabilized Knee Replacement System (ConforMIS)
- ConforMIS iUni® Unicondylar Knee Replacement System (ConforMIS)

FDA product codes: JWH, MBH, OIY, OOG

**Rationale**

Assessment of efficacy for new technology involves a determination of whether the technology improves health outcomes. The optimal study design for a therapeutic intervention is a randomized controlled trial (RCT) that includes clinically relevant measures of health outcomes. Intermediate outcome measures, also known as surrogate outcome measures, may also be adequate if there is an established link between the intermediate outcome and true health outcomes. Nonrandomized comparative studies and uncontrolled studies can sometimes provide useful information on health outcomes, but are prone to biases such as noncomparability of treatment groups, the placebo effect, and variable natural history of the condition.

There are a number of RCTs that compare patient-specific instrumentation (PSI) versus conventional instrumentation for total knee arthroplasty (TKA). Therefore, this evidence review will focus on systematic reviews and RCTs that address clinical outcomes. The surrogate outcome measure of a reduction in malalignment may be informative to support improvement with the new technology. However, a reduction in the
percentage of malaligned implants has not been definitively shown to result in improved clinical outcomes and is therefore not sufficient to demonstrate an improvement in clinical outcomes. In addition, as this is a relatively new technology, no long-term studies are currently available that could provide evidence on revision rates.

**Patient-Specific Instrumentation**

**Systematic Reviews**

Systematic reviews published to date have not found an improvement in accuracy or clinically significant decrease in operative time with PSI.

Thienpont et al included 8 RCTs and 8 cohort studies (total of 1755 patients) in their 2014 meta-analysis. The PSI systems used in the RCTs were Signature™ (Biomet), Zimmer Patient Specific Instruments® (Zimmer), TruMatch® (DePuy), Zimmer Patient Specific Instruments® (Zimmer), TruMatch® (DePuy), and Visionaire (Smith & Nephew). This systematic review found no significant difference in the likelihood of mechanical axis malalignment with PSI versus conventional TKA across all studies, or when divided by RCTs (RR [risk ratio]=1.14, p=0.445) and cohort studies (RR=0.70, p=0.289). Alignment of the tibial component was significantly worse in the coronal and sagittal planes when using PSI. For the femoral component, alignment was significantly better in the coronal plane but not in the sagittal plane with PSI. Axial alignment of the tibial and femoral components was not significantly different between PSI and conventional instrumentation. Funnel plots showed no strong evidence of publication bias.

A 2014 meta-analysis by Fu et al included 10 RCTs and a total of 837 knees. There were no significant differences between the 2 groups for outliers from a neutral mechanical axis or femoral component placement. Malalignment of the tibial component was higher with PSI in both the coronal plane (RR=2.50, p=0.02) and the sagittal plane (RR=1.47, p=0.02). Surgical time was shorter by a modest 3.54 minutes (weighted mean difference) with PSI. A funnel plot showed minimal evidence of publication bias. The 9 comparative studies (2 RCTs) in a 2014 meta-analysis by Voletti et al used 4 different PSI systems and included 957 knee arthroplasties. There was no significant difference between the treatment groups in the percentage of outliers greater than 3 degrees from target alignment (p=0.7), while standard instrumentation had greater accuracy in the mechanical axis (p=0.02). Sagittal alignment, operative time, intraoperative blood loss, and cost were similar between groups (p>0.1).

**RCTs**

Two additional RCTs, published after the search dates of the systematic reviews, compared PSI and conventional instrumentation. One RCT of 112 patients found no significant improvement in alignment with use of the Signature™ Personalized Patient Care System. Another RCT with 50 patients found no significant improvement in Knee Society Scores (KSS) at a minimum 6-month follow-up and an increase in the percentage of outliers with TruMatch® PSI (47% vs 6%, p<0.000). It was also reported that PSI was abandoned during surgery in 7 of 22 knees (31.8%) because of possible malalignment. In 55% the surgeon adjusted the joint space by increasing the bone (compared with 23% of control knees) and a different size of implant than was planned was needed in 41% of PSI procedures. A third publication reported clinical outcomes from 40 patients randomized to Zimmer® PSI or conventional instrumentation; alignment data had previously been reported and was included in the systematic reviews. Similar scores were obtained for the 2 groups for gait parameters and patient-reported outcomes (KSS, Knee Injury, and Osteoarthritis Outcome Score, and Short Form-12) at 3-month follow-up.
Ongoing and Unpublished Clinical Trials

A search of online site ClinicalTrials.gov in August 2014 found a number of ongoing trials on patient-specific cutting guides for TKA. Many of these trials are being conducted in Europe and are independent of manufacturer funding. Larger trials include:

- NCT02002624 - A multicenter randomized single-blind study with 140 patients that compared PSI with standard instrumentation. The outcome measures include mechanical axis and component positioning at 3 months. The study began in 2011 and was completed in July 2013.

- NCT01876654 - An open label randomized trial with the TruMatch® patient-specific cutting guide. The primary outcome is the femorotibial mismatch angle at 2 months after surgery. The study has an estimated enrollment of 64 patients with completion targeted for June 2014.

- NCT02096393 - A randomized double-blind trial of Zimmer Patient-Specific Instruments compared with standard instrumentation. The study began September 2013. It has a target enrollment of 100 patients with 10-year follow-up of functional outcomes completed in 2024.

- NCT01696552 - A randomized double-blind trial of the Signature™ Patient Care system compared with conventional instrumentation. Outcomes include implant positioning at 3 months, functional outcomes at 2 years, and x-ray analysis for alignment and possible osteolytic development at 10 years. The study has an estimated enrollment of 200 patients with completion of the primary outcome measure in June 2013 and the final outcome measure in 2020.

- NCT01072019 - A randomized open-label study of Signature™ custom guides compared with standard instrumentation. The primary outcome is patient dissatisfaction at up to 1 year. The study has an estimated enrollment of 165 patients with completion listed for March 2013. The posting was last verified in 2011.

- NCT02128464 - A randomized double-blind trial of the Visionaire™ customized cutting guide compared with conventional instrumentation in 100 patients. The primary outcome is mechanical axis at 3 months. The estimated completion date is December 2014.

- NCT01483066 - A randomized single-blinded comparison of ShapeMatch patient-specific cutting guides with conventional cutting guides. ShapeMatch uses a method that aligns the cutting guide with the patient’s anatomic alignment instead of the mechanical axis. Functional outcomes will be assessed at 2 years. The study has an estimated enrollment of 150 patients with completion expected December 2016.

Studies on custom knee implants were also identified.

- NCT02186587 - An open-label nonrandomized comparison of recovery at 6 months in patients receiving the ConforMIS custom total knee implant with the outcomes of patients who receive an off-the-shelf total knee implant. The study has an estimated enrollment of 115 patients with completion expected December 2014.

- NCT01117571 - A manufacturer-sponsored single arm Phase IV study of the ConforMIS iUni® Unicompartmental Knee Resurfacing Device. The primary outcome is function at 2 years. Annual revision rates through 10 years will also be
examined. The study has an enrollment of 120 patients with completion expected in 2020.

Summary of Evidence

A number of small randomized controlled trials have examined whether patient-specific cutting guides improve outcomes for total knee arthroplasty. Systematic reviews of these trials find no significant improvement in implant alignment, with some studies reporting worse alignment with patient-specific instrumentation (PSI). In addition, a substantial number of procedures are abandoned intraoperatively. If there is no improvement in alignment, it is unlikely that PSI as a category as a whole will improve clinical outcomes. However, larger RCTs examining the various PSI systems are in progress, and these systems differ in both planning and manufacturing. Therefore, future assessment of PSI should address the specific system used. Based on the evidence available at this time, use of custom made implants and patient-specific cutting guides and is considered investigational.

Supplemental Information

Practice Guidelines and Position Statements

No guidelines or position statements that mention custom cutting guides/blocks for total knee arthroplasty were identified.

U.S. Preventive Services Task Force Recommendations

Patient-specific cutting guides/blocks for total knee replacement are not a preventive service.

Medicare National Coverage

There is no national coverage determination (NCD). In the absence of an NCD, coverage decisions are left to the discretion of local Medicare carriers.

References

2. Blue Cross and Blue Shield Association Technology Evaluation Center. Computer-assisted navigation for total knee arthroplasty. Technology Assessment Feb 2007;Volume 22, Tab 10. PMID 18411501

Documentation Required for Clinical Review

- No records required

Coding

This Policy relates only to the services or supplies described herein. Benefits may vary according to benefit design; therefore, contract language should be reviewed before applying the terms of the Policy. Inclusion or exclusion of a procedure, diagnosis or device code(s) does not constitute or imply member coverage or provider reimbursement.

IE

The following services are considered investigational and therefore not covered for any indication.
### Policy History

This section provides a chronological history of the activities, updates and changes that have occurred with this Medical Policy.

<table>
<thead>
<tr>
<th>Effective Date</th>
<th>Action</th>
<th>Reason</th>
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<tbody>
<tr>
<td>11/26/2014</td>
<td>BCBSA Medical Policy adoption</td>
<td>Medical Policy Committee</td>
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### Definitions of Decision Determinations

**Medically Necessary:** A treatment, procedure or drug is medically necessary only when it has been established as safe and effective for the particular symptoms or diagnosis, is not investigational or experimental, is not being provided primarily for the convenience of the patient or the provider, and is provided at the most appropriate level to treat the condition.

**Investigational/Experimental:** A treatment, procedure or drug is investigational when it has not been recognized as safe and effective for use in treating the particular condition in accordance with generally accepted professional medical standards. This includes services where approval by the federal or state governmental is required prior to use, but has not yet been granted.

**Split Evaluation:** Blue Shield of California / Blue Shield of California Life & Health Insurance Company (Blue Shield) policy review can result in a Split Evaluation, where a treatment, procedure or drug will be considered to be investigational for certain indications or conditions, but will be deemed safe and effective for other indications or conditions, and therefore potentially medically necessary in those instances.

### Prior Authorization Requirements

This service (or procedure) is considered **medically necessary** in certain instances and **investigational** in others (refer to policy for details).

For instances when the indication is **medically necessary**, clinical evidence is required to determine **medical necessity**.

For instances when the indication is **investigational**, you may submit additional information to the Prior Authorization Department.
Within five days before the actual date of service, the Provider MUST confirm with Blue Shield that the member’s health plan coverage is still in effect. Blue Shield reserves the right to revoke an authorization prior to services being rendered based on cancellation of the member’s eligibility. Final determination of benefits will be made after review of the claim for limitations or exclusions.

Questions regarding the applicability of this policy should also be directed to the Prior Authorization Department. Please call 1-800-541-6652 or visit the Provider Portal www.blueshieldca.com/provider.

The materials provided to you are guidelines used by this plan to authorize, modify, or deny care for persons with similar illness or conditions. Specific care and treatment may vary depending on individual need and the benefits covered under your contract. These Policies are subject to change as new information becomes available.