# Bone Graft Substitutes

## Medical Coverage Policy

**Effective Date:** 02/23/2012  
**Revision Date:** 02/23/2012  
**Review Date:** 02/23/2012  
**Policy Number:** CLPD-0479-003  

**Change Summary:** Updated Description, Coverage Limitations, Background, Provider Claims Codes, Medical Terms, References

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### Disclaimer

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### Description

Bone grafts may be used in the treatment of delayed fracture unions, in spinal fusions, to bridge major bone defects or fill cavities created by tumor removal, cysts, or other causes. Bone graft material may come from any of a number of sources: from the individual’s own bones (autograft), from a bone bank (allograft), demineralized bone matrix, or bone graft substitutes, such as synthetic materials, ceramics (bone void fillers), collagen composites, composite cement materials, bone morphogenetic protein, or recombinant human bone morphogenetic protein.

#### Autograft

Autograft is considered the gold standard and is taken directly from the patient. The usual site for an autograft harvest is the posterior iliac crest. When autograft material...
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is of an insufficient volume, of poor quality, or cannot be used for any other reason, then another type of material must be used for the bone graft.

**Allograft**

Allograft is obtained from cadaveric bone and/or tissue from a bone bank and may be used alone or in combination with another material. Even when used alone, allograft must be processed to decrease the likelihood of disease transmission and immunogenic response. Examples of allograft-based bone graft substitutes include, but may not be limited to Grafton, OrthoBlast and TruFuse.

**Demineralized Bone Matrix (DBM)**

DBM is a type of allograft; it is produced by acid extraction of allograft bone (known as decalcification). Based on manufacturing techniques, DBM may be a freeze-dried powder, granules, gel, putty, or strips. Examples of DBM include, but may not be limited to, Accell, AlloFuse, Allomatrix, Grafton DBM, Intergro DBM, Magnifuse, Optefil, Origen DBM, OsteoSelect, OsteoSponge, and Progenix.

**Ceramics/Bone Void Fillers**

Ceramics are synthetically produced bone void fillers. As a conductive technology, ceramics are synthetic materials resulting from heating up chemically formed compounds that consequently bond together. There are many different methods to produce ceramics, and numerous chemical compounds that can be combined, including calcium sulfate – calcium composite or beta tricalcium phosphate. Examples of calcium sulfate-calcium composite include, but may not be limited to, Actifuse, Cem-Ostetic, PolyGraft, Pro-Dense, TruFit bone plugs, or TruRepair.

Examples of beta tricalcium phosphate include, but may not be limited to, Vitoss Bioactive Foam-2X, Conduit TCP Granules, FM-O2, Formagraft Bone Graft, GenerOs, Integra Mozaik, Integra Osteoconductive Scaffold, OsSatura TCP, Osteomatrix, or Synthes ChronOSS. (Refer to Coverage Limitations section).

**Bone Morphogenetic Proteins (BMP) and Recombinant Human Bone Morphogenetic Proteins (rhBMP)**

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Bone morphogenetic proteins are naturally occurring proteins found in human bone and play an active role in bone formation. There are currently fourteen bone morphogenetic proteins (BMPs) that have been identified. In addition to the fourteen BMPs, there are several recombinant human bone morphogenetic proteins (rhBMPs). Currently there are only two which have been developed for use - rhBMP-2 and rhBMP-7. An important use of rhBMP is for bone repair, especially in bones that have delayed union or nonunion of a fracture and to promote fusion of vertebrae (for information regarding spinal fusion surgery, please refer to the Spinal Fusion Surgery Medical Coverage Policy.) Recombinant human bone morphogenetic protein also plays a role in cartilage formation and repair of other musculoskeletal tissues.

Recombinant human bone morphogenetic proteins serve as alternatives or adjuncts to autologous (autografts) bone grafts. They are intended to promote bone formation and enhance fracture healing, and may be used in spinal fusion surgery for degenerative disease to promote bone growth that results in fusion. These proteins may also be used for individuals who have up to grade I spondylolisthesis. Recombinant human bone morphogenetic proteins have been proven safe in L2 (lumbar) through S1 (sacral) levels of the spine. Severe life threatening complications have been associated with cervical spine use. Another major application of bone grafting is for bone repair, especially for treatment of delayed union of tibial fractures.

Recombinant human bone morphogenetic proteins belong to a family of growth factors and are comprised of deoxyribonucleic acid (DNA) along with demineralized bone matrix. The rhBMP needs to stay in the region of repair to influence skeletal formation (healing). In order for this to happen, the rhBMPs must be utilized with a suitable carrier. One of the most common carriers is a collagen sponge.

Examples of U.S. Food and Drug Administration (FDA) approved rhBMP’s include, but may not be limited to:

- Infuse® Bone Graft (rhBMP-2)
- Infuse® Bone Graft/LT-Cage® Lumbar Tapered Fusion Device (with titanium cage) (rhBMP-2)
- INFUSE/MASTERGRAFT™ (rhBMP-2) (Refer to Coverage Limitations section)
• OP-1® Implant (rhBMP-7)

• OP-1® Putty (rhBMP-7) (Refer to Coverage Limitations section)

Platelet Rich Plasma (PRP)

Platelet rich plasma (PRP), which is harvested from a patient’s own blood, has been proposed as a treatment to accelerate healing of tendon/ligament injuries or aid in bone healing or grafting. PRP is prepared by obtaining a small amount of the patient’s blood, which is then centrifuged to separate the platelets from the other components found in blood. This higher concentration of platelets is thought to help target growth factors released by the platelets, which in turn may enhance and accelerate the healing of damaged tendons/ligaments, or aid in bone healing/grafting. (Refer to Coverage Limitations section). (Please note: For information regarding the use of PRP in wound healing, please refer to the Growth Factors Medical Coverage Policy.)

Cell-Based Substitute

One material proposed for use in combination with allograft is mesenchymal stem cells, obtained from bone marrow aspirate. This is referred to as cell-based substitute. Examples of cell-based substitutes include but may not be limited to Osteocel® Plus and Trinity™ Evolution. (Refer to Coverage Limitations section).

Bioactive Glass

Not to be confused with “window” glass, bioactive glass has a different chemical composition, and is more reactive to extracellular fluids and therefore bonds to bone. Due to this reaction, it is purported that the glass will release substances that are biocompatible and activates a mechanism that promotes new bone growth. Over time, the glass dissolves completely and is replaced by bone tissue. Examples of bone void fillers made with bioactive glass include but may not be limited to Interface and NovaBone. (Refer to Coverage Limitations section).

Combination Bone Graft Substitutes

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A newer practice in bone graft substitutes is to combine different materials, with the theory that each different property working together will aid in the healing and grafting process. Some of the more common combinations include using bone void filler with beta tricalcium phosphate (including but not limited to OpteMX and BiOstetic™), combination poly (ceramic bone void filler) with hyaluronic acid (including but not limited to InQu™) or DBM with bioactive glass (including but not limited to Origen® DBM with Bioactive Glass and NanoFuse® DBM). (Refer to Coverage Limitations section).

Bone Marrow Aspirate

Another purported practice has been to mix the individual’s bone marrow aspirate with the bone graft substitute, rather than blood or autologous bone. (Refer to Coverage Limitations section).

Coverage Determination

Note: The use of any rhBMP for dental procedures is not covered under the medical Plan.

Humana members MAY be eligible under the Plan for the following bone graft materials for enhancement of bone healing:

- Allograft; OR
- Autograft; OR
- Ceramic or synthetic bone void fillers (excluding beta tricalcium phosphate bone void fillers – see Coverage Limitations); OR
- Demineralized bone matrix (DBM); OR
- Recombinant human bone morphogenetic proteins (rhBMP)
  - Infuse® Bone Graft/LT-CAGE® Lumbar Tapered Fusion Device (rhBMP-2) for single-level anterior interbody lumbar fusion surgery when lumbar fusion
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criteria is met. (Please refer to Spinal Fusion Surgery Medical Coverage Policy; OR

- **Infuse** Bone Graft (rhBMP-2) as primary treatment of skeletally mature* patients with open tibial fractures free of infection following stabilization with intramedullary nail fixation; OR

- **OP-1** Implant (rhBMP-7) when used in skeletally mature* patients combined with intramedullary nail fixation for treatment of tibial fracture nonunion.

*(Skeletally mature refers to at least 18 years old or radiographic evidence of epiphyseal closure).

**Coverage Limitations**

Humana members may NOT be eligible under the Plan for use of the following bone graft substitute products to enhance bone healing:

- **Beta tricalcium phosphate bone void fillers** (e.g., Vitoss™ Bioactive Foam-2X, Conduit TCP Granules, FM-O2, Formagraft Bone Graft, GenerOs™, Integra Mozaik, Integra OS™ Osteoconductive Scaffold, OsSatura TCP®, Osteomatrix®, or Synthes ChronOS™); OR

- **Bioactive glass** (e.g., Interface or NovaBone); OR

- **Bone marrow aspirate** (as an adjunct to a spinal fusion, for nonunion fractures or when “mixed” with any bone graft substitute); OR

- **Cell-based substitutes** (utilizing mesenchymal stem cell therapy, e.g., Osteocel® Plus or Trinity™ Evolution); OR

- **Combination bone graft substitutes** (e.g., bone void filler with beta tricalcium phosphate [OpteMx or Bi-Ostetic™], combination poly (ceramic bone void filler) with hyaluronic acid [InQu™], or DBM with bioactive glass [Origen® DBM with Bioactive Glass or NanoFuse® DBM]); OR

- **Ignite** Kit; OR

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- **INFUSE/MASTERGRAFT™ (rhBMP-2); OR**

- **OP-1® Putty (rhBMP-7); OR**

- **Platelet rich plasma (PRP)** for any indication, including but not limited to the following:
  - Bone healing and fusion; OR
  - Joint pain or repair; OR
  - Ligament or tendon injuries; OR
  - Plantar fasciitis

These technologies are considered experimental/investigational as they are not identified as widely used and generally accepted for the proposed use as reported in nationally recognized peer-reviewed medical literature published in the English language.

Humana members may **NOT** be eligible under the Plan for the use of **Infuse® Bone Graft (rhBMP-2) and/or Infuse® Bone Graft/LT-CAGE® Lumbar Tapered Fusion Device (rhBMP-2)** for any other indications not listed in the coverage determination section, which include, but may not be limited to:

- Active infection at the operative site; OR
- Active malignancy; OR
- Cervical spine fusions; OR
- Combined with a carrier other than collagen or with a fusion device other than cage; OR
- Compartment syndrome of the affected limb; OR
- Craniofacial applications including sinus augmentation and/or alveolar ridge augmentation; OR

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- Inadequate neurovascular status; OR
- Known hypersensitivity to bovine Type I collagen, rhBMP-2 or other components of the formulation; OR
- Non-anterior approaches to lumbar fusion; OR
- Patients who are skeletally immature (less than 18 years old or have no radiographic evidence of epiphyseal closure); OR
- Pregnant women; OR
- Primary treatment of closed tibial fractures; OR
- Treatment of delayed union or nonunion of tibial fracture as part of a planned, staged reconstruction; OR
- Utilization in the vicinity of a resected or extant tumor.

These technologies are considered experimental/investigational as they are not identified as widely used and generally accepted for the proposed use as reported in nationally recognized peer-reviewed medical literature published in the English language.

Humana members may NOT be eligible under the Plan for the use of OP-1® Implant (rhBMP-7) for any other indications not listed in the coverage determination section, which include, but may not be limited to:

- Cervical spine fusions: OR
- Craniofacial applications including sinus augmentation and/or alveolar ridge augmentation; OR
- Known allergy to OP-1 or collagen; OR
- Patients who are skeletally immature (less than 18 years old or have no
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Background

You can learn more about degenerative disc disease, spondylolisthesis, fractures, and bone grafting from the following sites:

- American Academy of Orthopedic Surgeons (AAOS) - http://www.aaos.org

Medical Alternatives

Humana may offer a disease management program for this condition. Call the number on your member identification card to ask about our programs to help you manage your care.

To make the best health decision for your individual needs, consult your physician.

Provider Claims Codes

All provider claims codes surrounding this topic may not be included in the following table:

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<th>Description</th>
<th>Comments</th>
</tr>
</thead>
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<tr>
<td>20900</td>
<td>Bone graft, any donor area; minor or small (e.g., dowel or button)</td>
<td></td>
</tr>
<tr>
<td>20902</td>
<td>Bone graft, any donor area; major or large</td>
<td></td>
</tr>
<tr>
<td>20930</td>
<td>Allograft, morselized, or placement of osteopromotive material, for spine surgery only (List separately in addition to code for primary procedure)</td>
<td></td>
</tr>
<tr>
<td>20931</td>
<td>Allograft, structural, for spine surgery only (List separately in addition to code for primary procedure)</td>
<td></td>
</tr>
<tr>
<td>20936</td>
<td>Autograft for spine surgery only (includes harvesting the graft); local (e.g., ribs, spinous process, or laminar fragments) obtained from same incision (List separately in addition to code for primary procedure)</td>
<td></td>
</tr>
<tr>
<td>20937</td>
<td>Autograft for spine surgery only (includes harvesting the graft); morselized (through separate skin or fascial incision) (List separately in addition to code for primary procedure)</td>
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</tr>
<tr>
<td>20938</td>
<td>Autograft for spine surgery only (includes harvesting the graft); structural, bicortical or tricortical (through separate skin or fascial incision) (List separately in addition to code for primary procedure)</td>
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</tr>
<tr>
<td>20955</td>
<td>Bone graft with microvascular anastomosis; fibula</td>
<td></td>
</tr>
<tr>
<td>20956</td>
<td>Bone graft with microvascular anastomosis; iliac crest</td>
<td></td>
</tr>
<tr>
<td>20957</td>
<td>Bone graft with microvascular anastomosis; metatarsal</td>
<td></td>
</tr>
<tr>
<td>20962</td>
<td>Bone graft with microvascular anastomosis; other than fibula, iliac crest, or metatarsal</td>
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<tr>
<td>23145</td>
<td>Excision or curettage of bone cyst or benign tumor of clavicle or scapula; with autograft (includes obtaining graft)</td>
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<tr>
<td>23146</td>
<td>Excision or curettage of bone cyst or benign tumor of clavicle or scapula; with allograft</td>
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</tr>
<tr>
<td>23155</td>
<td>Excision or curettage of bone cyst or benign tumor of proximal humerus; with autograft (includes obtaining graft)</td>
<td></td>
</tr>
<tr>
<td>23156</td>
<td>Excision or curettage of bone cyst or benign tumor of proximal humerus; with allograft</td>
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<th>Description</th>
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<tbody>
<tr>
<td>24115</td>
<td>Excision or curettage of bone cyst or benign tumor, humerus; with autograft (includes obtaining graft)</td>
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<td>24116</td>
<td>Excision or curettage of bone cyst or benign tumor, humerus; with allograft</td>
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<tr>
<td>24125</td>
<td>Excision or curettage of bone cyst or benign tumor of head or neck of radius or olecranon process; with autograft (includes obtaining graft)</td>
</tr>
<tr>
<td>24126</td>
<td>Excision or curettage of bone cyst or benign tumor of head or neck of radius or olecranon process; with allograft</td>
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<tr>
<td>24435</td>
<td>Repair of nonunion or malunion, humerus; with iliac or other autograft (includes obtaining graft)</td>
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<tr>
<td>25125</td>
<td>Excision or curettage of bone cyst or benign tumor of radius or ulna (excluding head or neck of radius and olecranon process); with autograft (includes obtaining graft)</td>
</tr>
<tr>
<td>25126</td>
<td>Excision or curettage of bone cyst or benign tumor of radius or ulna (excluding head or neck of radius and olecranon process); with allograft</td>
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<tr>
<td>25135</td>
<td>Excision or curettage of bone cyst or benign tumor of carpal bones; with autograft (includes obtaining graft)</td>
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<tr>
<td>25136</td>
<td>Excision or curettage of bone cyst or benign tumor of carpal bones; with allograft</td>
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<tr>
<td>25405</td>
<td>Repair of nonunion or malunion, radius OR ulna; with autograft (includes obtaining graft)</td>
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<tr>
<td>25420</td>
<td>Repair of nonunion or malunion, radius AND ulna; with autograft (includes obtaining graft)</td>
</tr>
<tr>
<td>25425</td>
<td>Repair of defect with autograft; radius OR ulna</td>
</tr>
<tr>
<td>25426</td>
<td>Repair of defect with autograft; radius AND ulna</td>
</tr>
<tr>
<td>25431</td>
<td>Repair of nonunion of carpal bone (excluding carpal scaphoid (navicular)) (includes obtaining graft and necessary fixation), each bone</td>
</tr>
<tr>
<td>25440</td>
<td>Repair of nonunion, scaphoid carpal (navicular) bone, with or without radial styloidectomy (includes obtaining graft and necessary fixation)</td>
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<tr>
<td>26205</td>
<td>Excision or curettage of bone cyst or benign tumor of metacarpal; with autograft (includes obtaining graft)</td>
</tr>
</tbody>
</table>

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</thead>
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<tr>
<td>26215</td>
<td>Excision or curettage of bone cyst or benign tumor of proximal, middle, or distal phalanx of finger; with autograft (includes obtaining graft)</td>
</tr>
<tr>
<td>26546</td>
<td>Repair non-union, metacarpal or phalanx (includes obtaining bone graft with or without external or internal fixation)</td>
</tr>
<tr>
<td>27055</td>
<td>Excision of bone cyst or benign tumor, wing of ilium, symphysis pubis, or greater trochanter of femur; superficial, includes autograft, when performed</td>
</tr>
<tr>
<td>27056</td>
<td>Excision of bone cyst or benign tumor, wing of ilium, symphysis pubis, or greater trochanter of femur; deep (subfascial), includes autograft, when performed</td>
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<tr>
<td>27057</td>
<td>Excision of bone cyst or benign tumor, wing of ilium, symphysis pubis, or greater trochanter of femur; with autograft requiring separate incision</td>
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<tr>
<td>27170</td>
<td>Bone graft, femoral head, neck, intertrochanteric or subtrochanteric area (includes obtaining bone graft)</td>
</tr>
<tr>
<td>27356</td>
<td>Excision or curettage of bone cyst or benign tumor of femur; with allograft</td>
</tr>
<tr>
<td>27357</td>
<td>Excision or curettage of bone cyst or benign tumor of femur; with autograft (includes obtaining graft)</td>
</tr>
<tr>
<td>27472</td>
<td>Repair, nonunion or malunion, femur, distal to head and neck; with iliac or other autogenous bone graft (includes obtaining graft)</td>
</tr>
<tr>
<td>27637</td>
<td>Excision or curettage of bone cyst or benign tumor, tibia or fibula; with autograft (includes obtaining graft)</td>
</tr>
<tr>
<td>27638</td>
<td>Excision or curettage of bone cyst or benign tumor, tibia or fibula; with allograft</td>
</tr>
<tr>
<td>27722</td>
<td>Repair of nonunion or malunion, tibia; with sliding graft</td>
</tr>
<tr>
<td>27724</td>
<td>Repair of nonunion or malunion, tibia; with iliac or other autograft (includes obtaining graft)</td>
</tr>
<tr>
<td>28102</td>
<td>Excision or curettage of bone cyst or benign tumor, talus or calcaneus; with iliac or other autograft (includes obtaining graft)</td>
</tr>
<tr>
<td>28103</td>
<td>Excision or curettage of bone cyst or benign tumor, talus or calcaneus; with allograft</td>
</tr>
</tbody>
</table>

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<tbody>
<tr>
<td>28106</td>
<td>Excision or curettage of bone cyst or benign tumor, tarsal or metatarsal, except talus or calcaneus; with iliac or other autograft (includes obtaining graft)</td>
<td></td>
</tr>
<tr>
<td>28107</td>
<td>Excision or curettage of bone cyst or benign tumor, tarsal or metatarsal, except talus or calcaneus; with allograft</td>
<td></td>
</tr>
<tr>
<td>28322</td>
<td>Repair, nonunion or malunion; metatarsal, with or without bone graft (includes obtaining graft)</td>
<td></td>
</tr>
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### HCPCS Code(s)

<table>
<thead>
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<td>C9359</td>
<td>Porous purified collagen matrix bone void filler (Integra Mozaik Osteoconductive Scaffold Putty, Integra OS Osteoconductive Scaffold Putty), per 0.5 cc</td>
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<td>C9362</td>
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### ICD-9 Procedure Code(s)

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<tr>
<td>76.91</td>
<td>Other operations on facial bones and joints; Bone graft to facial bone</td>
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<tr>
<td>77.70</td>
<td>Incision, excision and division of other bones; Excision of bone for graft; unspecified site</td>
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<tr>
<td>77.71</td>
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<td>77.73</td>
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<td>77.74</td>
<td>Incision, excision and division of other bones; Excision of bone for graft; carpals and metacarpals</td>
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</tbody>
</table>

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### Bone Graft Substitutes

**Effective Date:** 02/23/2012  
**Revision Date:** 02/23/2012  
**Review Date:** 02/23/2012  
**Policy Number:** CLPD-0479-003  
**Page:** 14 of 21

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<td>77.76</td>
<td>Incision, excision and division of other bones; Excision of bone for graft; patella</td>
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<td>77.77</td>
<td>Incision, excision and division of other bones; Excision of bone for graft; tibia and fibula</td>
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<td>77.78</td>
<td>Incision, excision and division of other bones; Excision of bone for graft; tarsals and metatarsals</td>
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<td>77.79</td>
<td>Incision, excision and division of other bones; Excision of bone for graft; other</td>
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<td>78.01</td>
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<td>Other operations on bones, except facial bones; Bone graft; carpals and metacarpals</td>
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<td>78.06</td>
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<td>78.09</td>
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<td>84.52</td>
<td>Insertion of recombinant bone morphogenetic protein</td>
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<tr>
<td>84.55</td>
<td>Insertion of bone void filler</td>
</tr>
</tbody>
</table>

**Medical Terms**

**Adjunct** - Something added to another thing but not essential to it.

**Allograft** - Graft of tissue obtained from a donor of the same species as, but with a

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different genetic make-up from the recipient, as a tissue transplant between two humans.

**Alveolar Ridge** - A ridge that forms the borders of the upper and lower jaws and contains the sockets of the teeth.

**Anterior** - Situated toward the front of the body.

**Autograft** - Tissue or organ that is grafted into a new position on the body of the individual from which it was removed.

**Autologous** - Derived from the same individual.

**Bovine** - Of, or pertaining to cattle; in this instance, tissue obtained from cattle.

**Cadaver** - Dead human body; a corpse.

**Cartilage** - Tough, elastic, fibrous connective tissue found in various parts of the body.

**Centrifuge** - Device which rotates at a very high rate of speed to separate solids from liquid.

**Cervical** - Describes the upper spine (neck) area.

**Collagen** - Fibrous protein constituent of bone, cartilage, tendon, and other connective tissue. It is converted into gelatin by boiling.

**Compartment Syndrome** - A condition in which the blood supply to a muscle is cut off because the muscle swells and is constricted by the connective tissue around it.

**Craniofacial** - Of, pertaining to, or affecting the cranium and face.

**Degenerative** - Of, relating to, causing, or characterized by degeneration; deterioration with corresponding impairment or loss of function.

**Degenerative Disc Disease** - Breakdown or wearing out of an intervertebral disc; usually affects multiple levels of discs.
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**Deoxyribonucleic Acid (DNA)** - Material inside the middle of cells that carries genetic information.

**Disc** - Round, flattened, plate-like structure in an animal, such as an intervertebral disc.

**Epiphyseal** - Part or process of a bone separated from the main body of the bone by a layer of cartilage and subsequently uniting with the bone through further ossification.

**Extant** - In existence; not destroyed or lost.

**Food and Drug Administration (FDA)** - Governmental agency responsible for ensuring the safety and effectiveness of all drugs, biologics, vaccines, and medical devices; it evaluates and approves/denies new drugs/medical devices for use by the general public.

**Fusion** - Union, or binding together, of adjacent parts or tissues.

**Grade I Spondylolisthesis** - Description of the degree of severity of the spondylolisthesis. Grade I is the least advanced; only 25% of the vertebral body has slipped forward.

**Graft** - Portion of living tissue surgically transplanted from one part of an individual to another or from one individual to another, for its adhesion and growth.

**Hypersensitivity** - Especially sensitive; allergic to a substance to which persons do not normally react.

**Iliac Crest** - Long, curved upper border of the wing of the ilium.

**Infection** - Invasion by and multiplication of pathogenic microorganisms in a bodily part or tissue, which may produce subsequent tissue injury and progress to overt disease through a variety of cellular or toxic mechanisms.

**Intramedullary** - Within the bone marrow.

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**Ligament** - Fibrous connective tissue at a joint that connects one bone to another.

**Lumbar** - Lower section of the spine (the low back).

**Malignancy** - Usually used interchangeably with the term cancer, but also describes a clinical course that progresses rapidly to death.

**Morphogenetic** - Formation of the structure of an organism or part; differentiation and growth of tissues and organs during development.

**Musculoskeletal** - Refers to the muscles, tendons, ligaments, cartilage, and bones.

**Neural** - Pertaining to a nerve or the nervous system.

**Neurovascular** - Pertaining to the nerves and blood vessels.

**Nonunion** - Failure of a broken bone to heal.

**Platelets** - Smallest component of the blood; responsible for assisting in clotting or wound healing; also known as a thrombocyte.

**Posterior** - Toward the back of the body.

**Recombinant** - Genetic material produced when segments of DNA from different sources are joined to produce recombinant DNA; of or resulting from new combinations of genetic material.

**Resected** - To perform a resection on.

**Spinal** - Of, pertaining to, or in the region of, the backbone, or vertebral column.

**Synthetic** - Not of natural origin; prepared or made artificially.

**Tendon** - Fibrous, strong connective tissue that connects muscle to bone.

**Tibial** - Refers to the long bone between the knee and foot.
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**Tumor** - Abnormal growth of tissue resulting from uncontrolled, progressive multiplication of cells and serving no physiological function; a neoplasm.

**Vertebrae** - One of the 33 bones in the cervical, thoracic and lumbar regions that make up the spinal column.

**References**


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