Table 1. Bone replacement grafts

Human bone
Autogenous grafts (autografts)
Extraoral
Intraoral
Allogeneic grafts (allografts)
Fresh frozen bone
Freeze-dried bone allografts
Demineralized freeze-dried bone allografts
Bone substitutes
Xenogeneic grafts (xenografts)
Bovine-derived hydroxyapatite
Coralline calcium carbonate
Alloplastic grafts (alloplasts)
Polymers
Bioceramics
Tricalcium phosphate
Hydroxyapatite
dense, nonporous, nonresorbable
porous, nonresorbable (xenograft)
resorbable hydroxyapatite derived at low temperature
Bioactive glasses

Rationale and objectives of bone replacement grafts

Periodontal therapy is directed not only at inflammation control but also at pocket reduction and correction of associated bone defects. Moderate to severe periodontal defects are often not amenable to osseous resection without further compromising the support of the involved and adjacent teeth. When applicable, regeneration of the lost bone and periodontal attachment improves the support of the tooth and hopefully its long-term prognosis. Bone replacement grafts have been used to achieve this end. Bone replacement grafts have been shown to produce greater clinical bone defect fill than flap debridement alone (11, 23, 44, 57). Histological reports have confirmed their ability to support new attachment in the apical portion of periodontal defects (18, 23, 68). Complete restitution is not likely; however, with bone replacement grafts some regeneration or new attachment is more likely to occur (12).

The ideal bone replacement graft should be able to trigger osteogenesis, cementogenesis and formation of a functional periodontal ligament. Osteogenesis, the formation of mineralized bone by transplanted osteoblasts, is only achieved with autogenous grafts (76). Cellular elements or progenitor cells of the autogenous graft have to be present for this to occur. Other types of bone replacement grafts do not provide any cellular elements. The best case scenario for these bone replacement grafts would be osteoinduction, which is the stimulation of phenotypic conversion of progenitor cells within the healing wound to those that can form osseous tissue. Currently, demineralized freeze-dried human bone and bone morphogenetic proteins may fulfill this role (95, 96). Most bone replacement grafts are osteoconductive, relatively inert filling materials, and integrate with new bone. Osteoconductive materials provide a scaffold to allow bone ingrowth and deposition and may support significant improvement in clinical probing depth and attachment levels. Histologically, these bone replacement grafts have produced limited regeneration.

History of bone replacement grafts

Historically, autogenous bone grafts were the first bone replacement grafts to be reported for periodontal applications. Autogenous bone from extraoral and intraoral sources was the focus of initial attention, being an accessible and desirable graft. Allogeneic freeze-dried bone was introduced to periodontics in the early 1970s, while demineralized allogeneic freeze-dried bone gained wider application in the late 1980s with an even increasing market share in the 1990s. The introduction of xenogeneic and alloplastic bone replacement grafts for periodontal use occurred during the same time.

Regenerative therapy with bone replacement grafts did not gain acceptance as predictable therapy until the 1980s. Controversy still remains as to whether new attachment (regeneration) at a coronal level is achieved or whether primarily a long junctional epithelium (repair) occurs as found with flap debridement surgery alone. Currently, the ability of bone replacement grafts to bond to bone and to become slowly replaced with host bone is being examined. Hence, resorbability and the ability of a graft material to enhance osteoconduction are the impetus behind the development of bone replacement grafts available today.

Autogenous grafts (autografts)

The use of extraoral autogenous bone grafts has been scarcely reported in the periodontal literature. Iliac cancellous bone and marrow were of initial interest due to a high potential for true osteogenesis (20, 87). Despite a relatively low frequency of root resorption associated with the use of fresh iliac grafts (45), this observation has limited their clinical use.