Bone Substitutes in Dental Practice

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Objective

- Perform a landscape search in the area of Bone Substitutes and with application in dental practice
- Use PCS to derive insights and gain competitive perspective
- Understand the value chain and recent M&A activities

Introduction

- Several non-biological materials are already being used to increase the alveolar bone volume to support dental implants. Stem cell therapy has emerged as a promising biological substitute or adjuvant to enhance bone healing [Miguita L]
- Bone morphogenetic protein 2 is shown to be effective as an inducer of bone formation process independent biomaterial used mainly for accelerating the resorption process of the framework [Da Silva de Oliveira JC]
- An implant simultaneously placed with sinus augmentation using rhBMP-2-loaded synthetic bone substitute can be successfully osseointegrated, even when only a limited bone height is available [Myung-Jae Joo]
- ?-TCP(Tri-Calcium Phosphate) presents the same behavior as autogenous bone graft, which makes it a good bone substitute [Pereira RS]

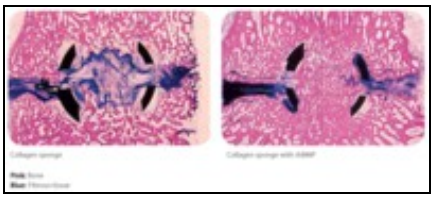


Fig. INFUSE Bone Graft-Medtronics



Fig. Geistlich Bio-Oss

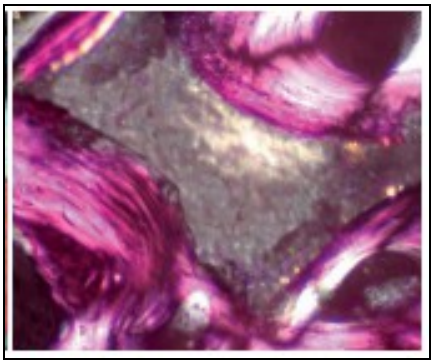


Fig. Polarized image displays osseointegration of Straumann BoneCeramic particle in lamellar type of bone

Search in PCS

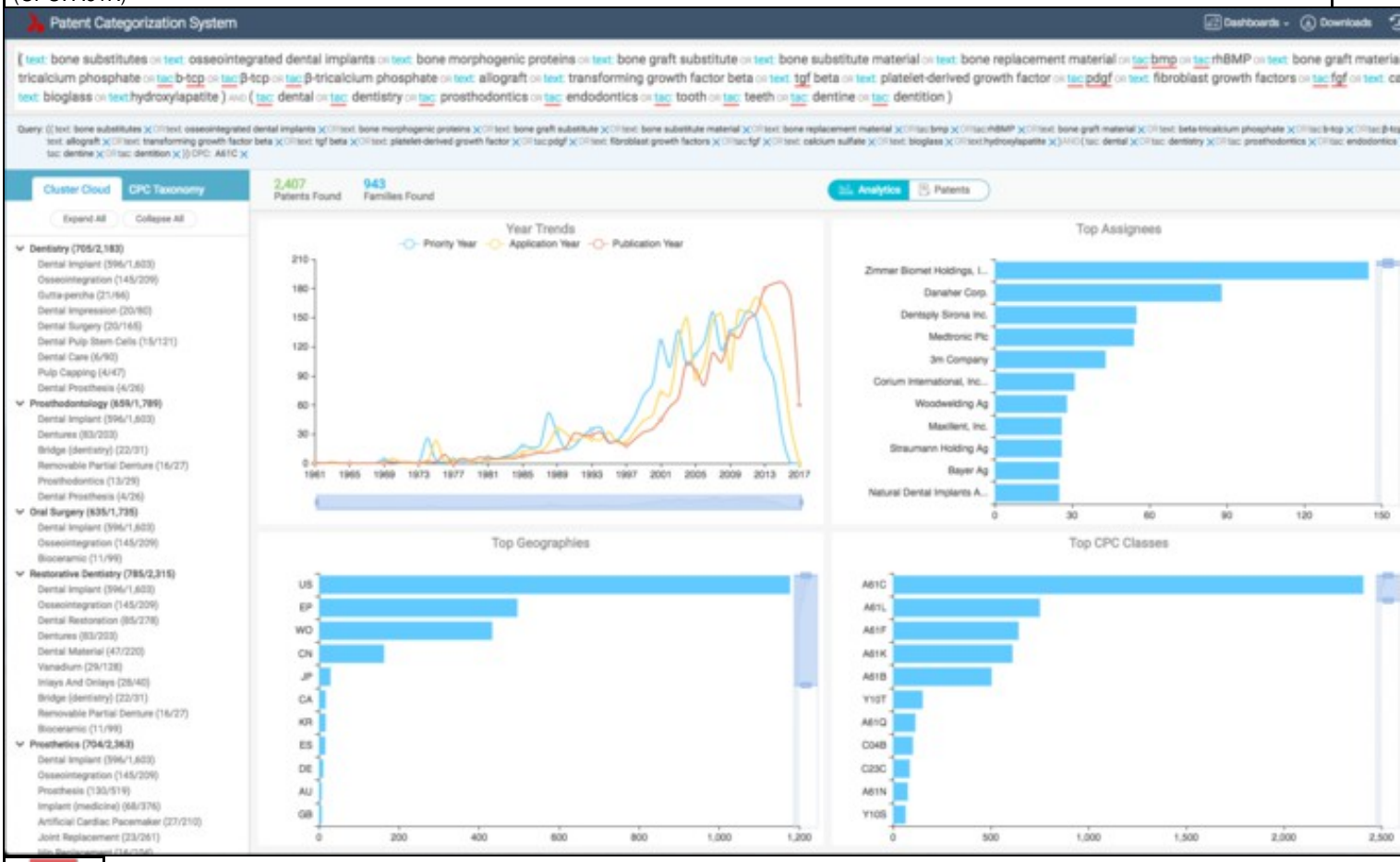
- Search Strategy:

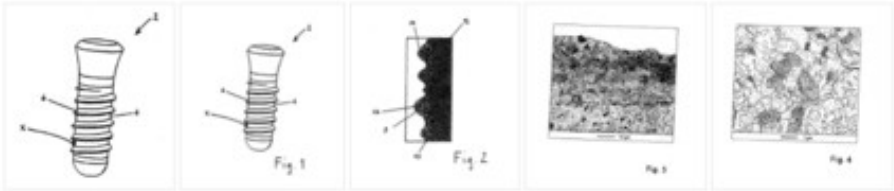
(text: bone substitutes OR text: osseointegrated dental implants OR text: bone morphogenic proteins OR text: bone graft substitute OR text: bone substitute material OR text: bone replacement material OR tac:bmp OR tac: rhBMP OR text: bone graft material OR text: beta-tricalcium phosphate OR tac:b-tcp OR tac:?-tcp OR tac:?-tricalcium phosphate OR text: allograft OR text: transforming growth factor beta OR text: tgf beta OR text: platelet-derived growth factor OR tac: pdgf OR text: fibroblast growth factors OR tac: fgf OR text: calcium sulfate OR text: bioglass OR text:hydroxylapatite) AND

(tac: dental OR tac: dentistry OR tac: prosthodontics OR tac: endodontics OR tac: tooth OR tac: teeth OR tac: dentine OR tac: dentition)

AND

(CPC: A61K)





Description

0001 The present invention relates to a process for preparing an osteointegrative surface on a ceramic body, according to claim 1, as well as to said body, according to claim 16. The invention further relates to the use of the body as an implant, according to claim 18, in particular a dental implant.

0002 Implants, such as dental implants, are well known in the art. They generally consist of a material, which is biocompatible and which additionally has a low elastic modulus and a high strength.

0003 Apart from its biocompatibility and its mechanical properties, the osteointegrative properties of an implant are usually of major importance. The term osteointegration designates the direct structural and functional connection between living bone and the surface of the load-bearing implant. A good osteointegration means that the implant, after reaching a primary stability by screwing it into the bone, safely ossifies within a short healing time so that a permanent bond between implant and bone is obtained.

Claims

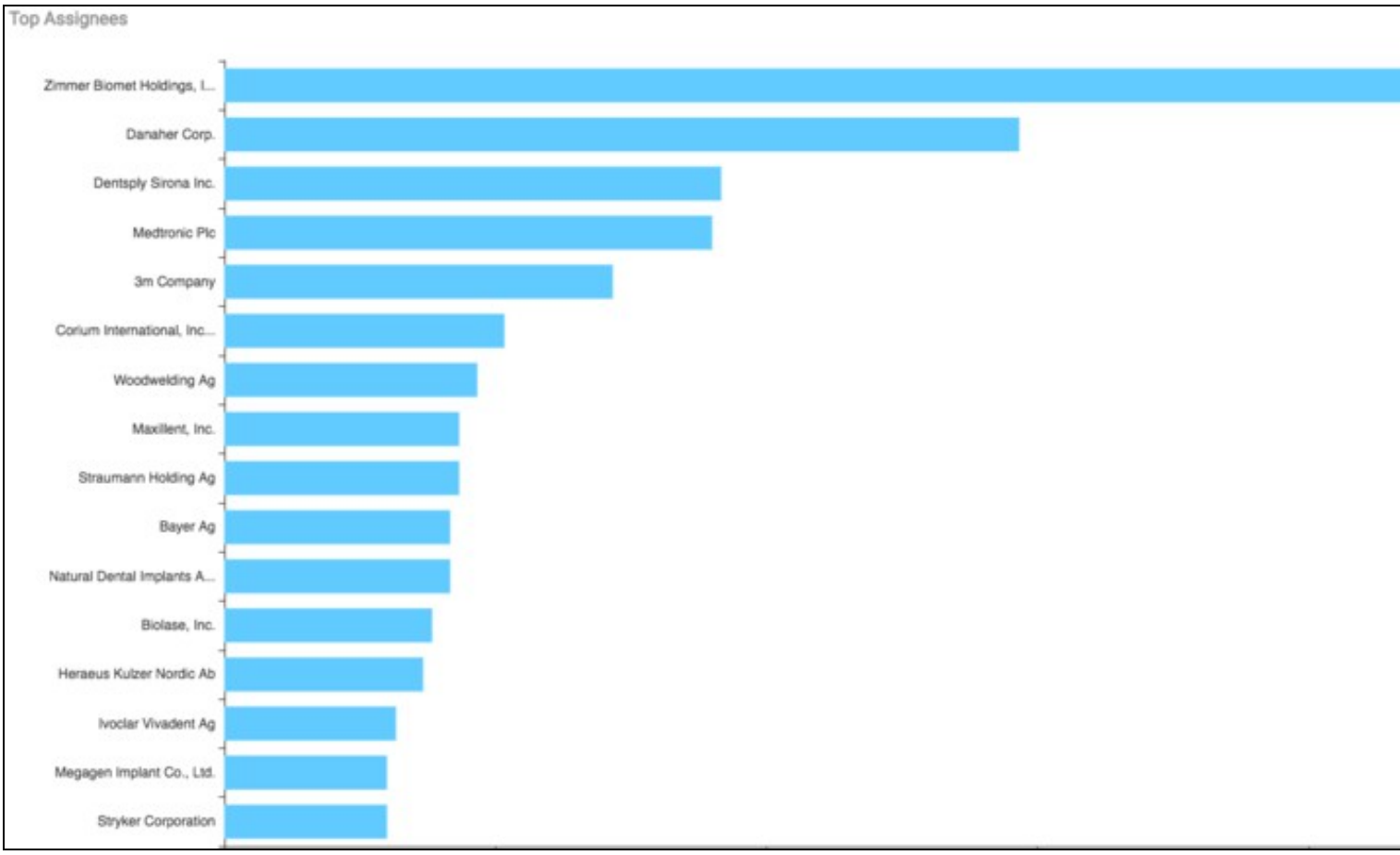
1 Process for preparing an osteointegrative surface on a ceramic body by chemically modifying at least a part of the surface of the body, said process comprising the subsequent steps ofdepositing a calcium phosphate mineral on the surface of a ceramic basic body by projecting agglomerates of particles comprising the calcium phosphate mineral towards the basic body, andheating the basic body with the calcium phosphate mineral deposited thereon.

2 Process according to claim 1 , wherein the basic body with the calcium phosphate mineral deposited thereon is heated to a temperature at which the calcium phosphate mineral is integrated into the basic body.

3 Process according to claim 1 , wherein the basic body with the calcium phosphate mineral deposited thereon is heated to a temperature of at least 1100° C.

4 Process according to claim 1 , wherein the calcium phosphate mineral is selected from the group consisting of hydroxylapatite, fluorapatite, β (beta) tricalcium phosphate and α(alpha)-tricalcium phosphate.

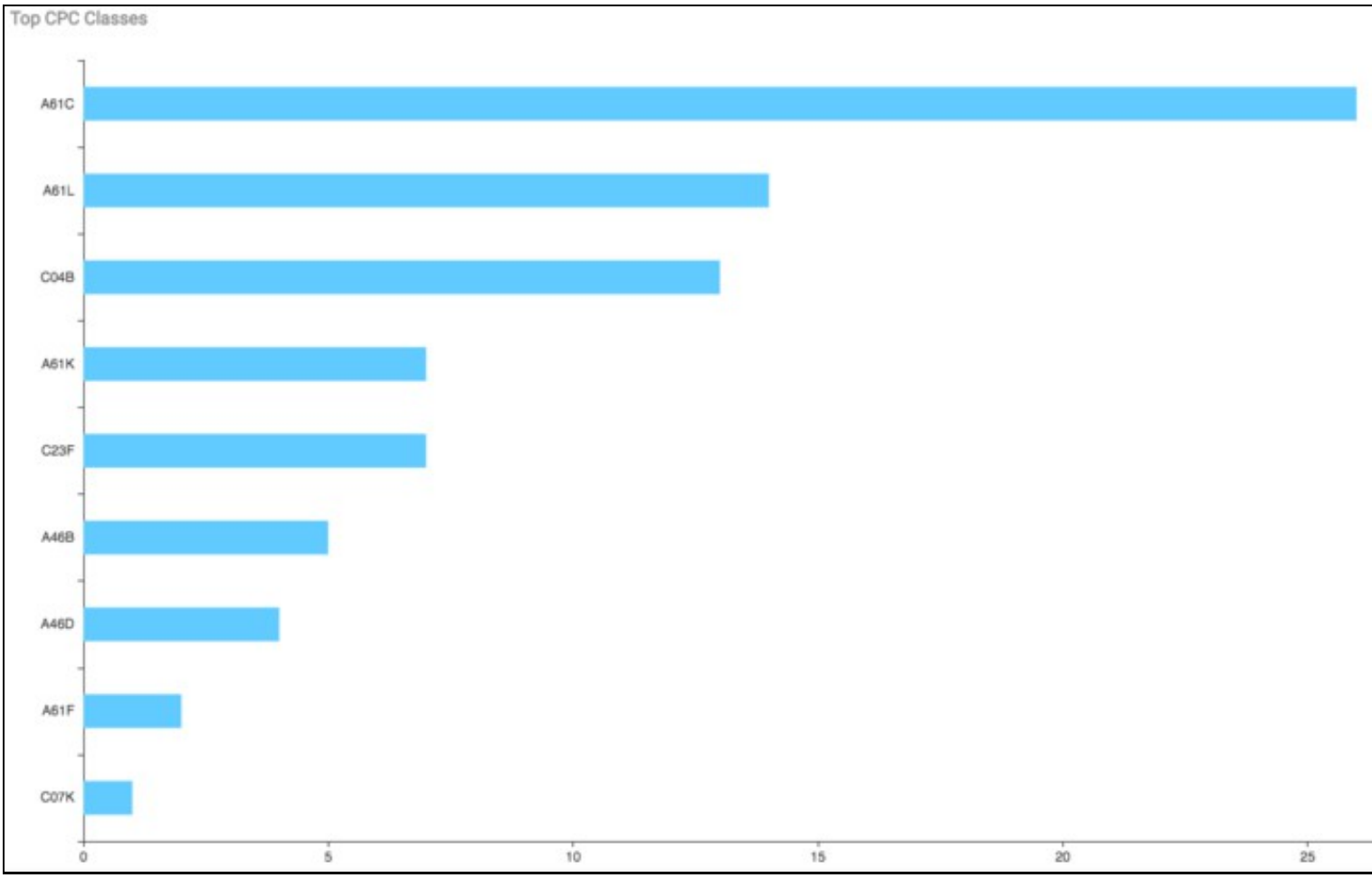
Top Assignees



- The top companies are big players in dental implants and devices companies:
    - ♦ Dentsply Sirona
    - ♦ Institut Straumann
    - ♦ Heraeus Kulzer
    - ♦ Danaher
- Various medical device companies that have also patented technologies in this space:
    - ♦ Zimmer Biomet
    - ♦ Medtronics
    - ♦ Stryker
- 3M, the material science company also has patents in this area

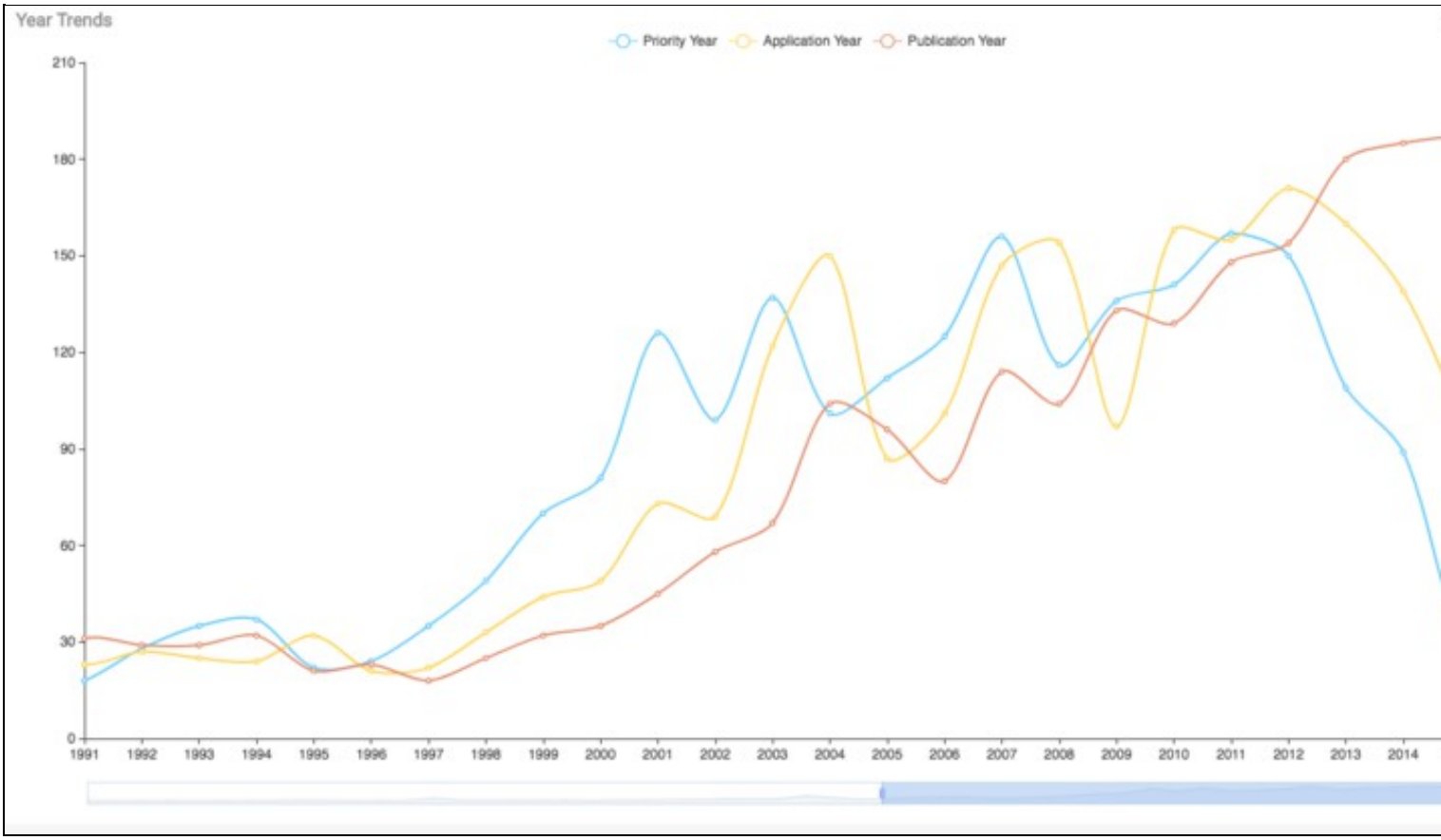
Bibliographic Analytics

Main CPC?s



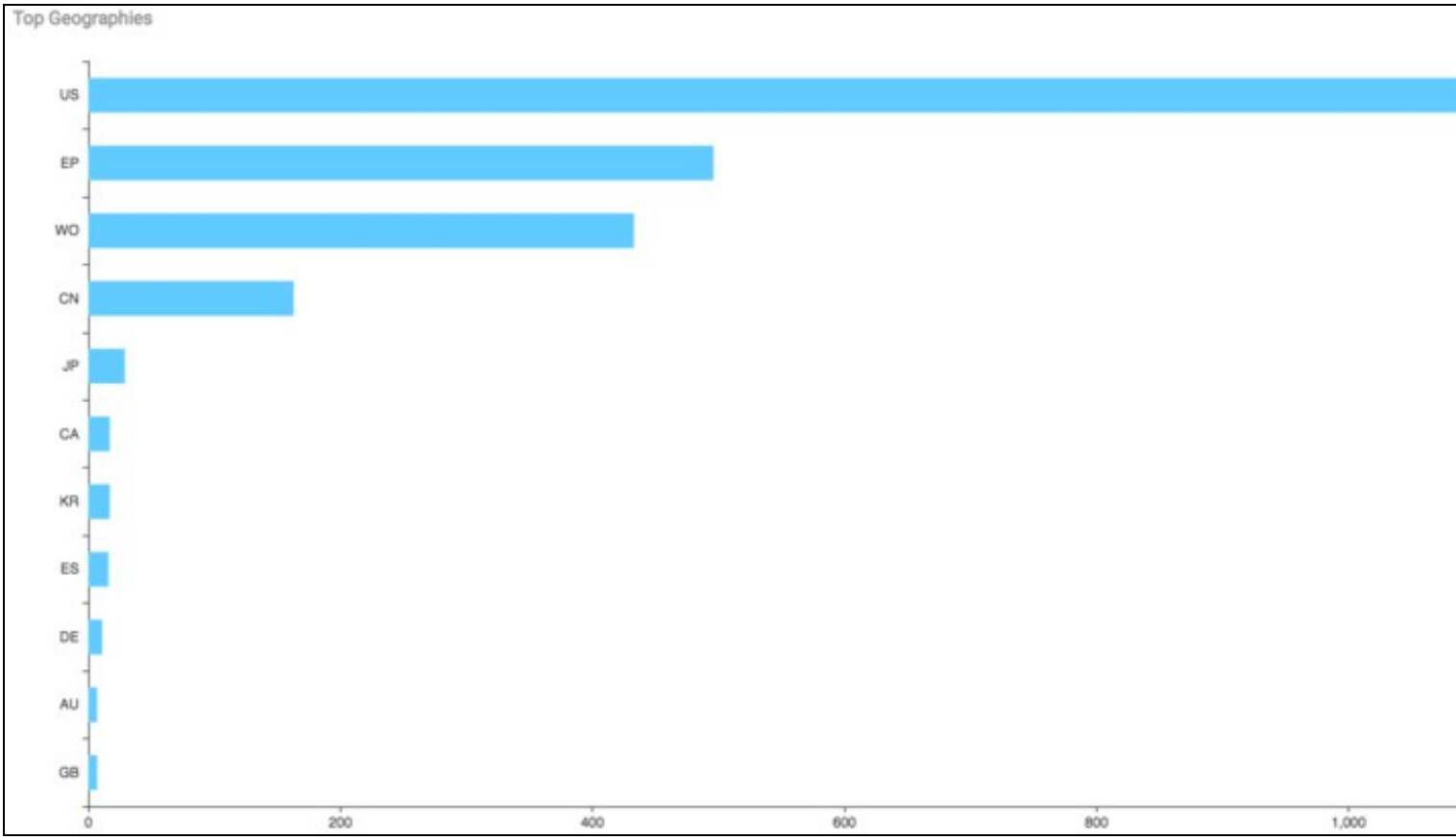
Apart from dentistry(A61C), many patents have classes for methods or apparatus for surgical procedures(A61L) and cements and glass ceramics(C04B)

IP Activity



IP activity is on a surge in the last 20 years, with a peak in 2016

Geographical Distribution



Most of the patents are from US or Europe. Very little from China. There is hardly any activity from other geographies

Top Assignees vs CPCs



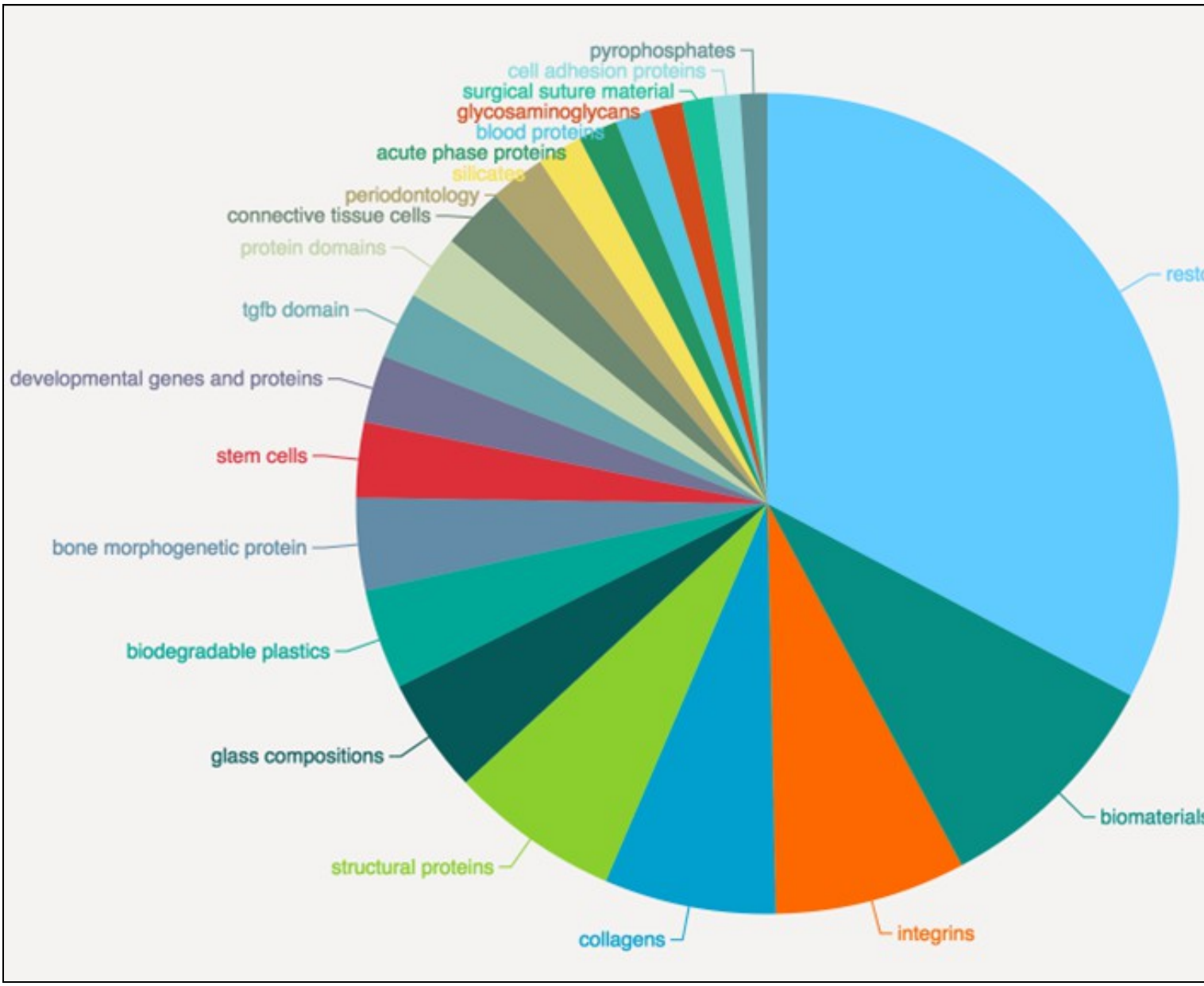
- Most of the top companies have patents in
  - dentistry(A61C)
  - methods or apparatus for surgical procedures(A61L)
  - implants & prosthesis (A61F)
  - medical & dental preparations(A61K)

- Companies having patents in cements and glass ceramics(C04B) and coating and cleaning of metallic materials (C23C & C23F) are:

Zimmer Biomet

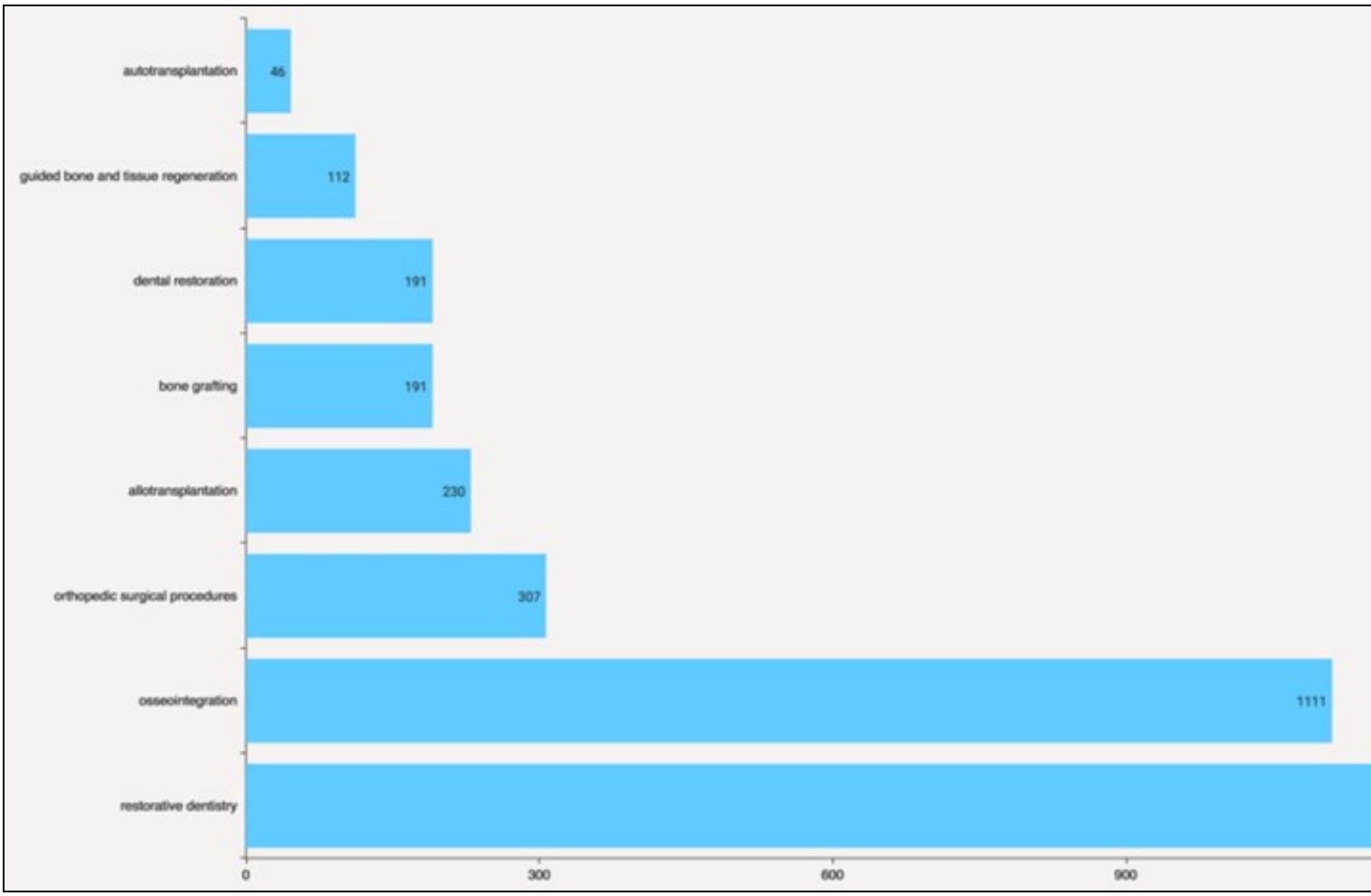
-
  - Straumann
  - Dentsply
  - Calcitec
  - Bionet
  - 3M

Top Categories and Concepts

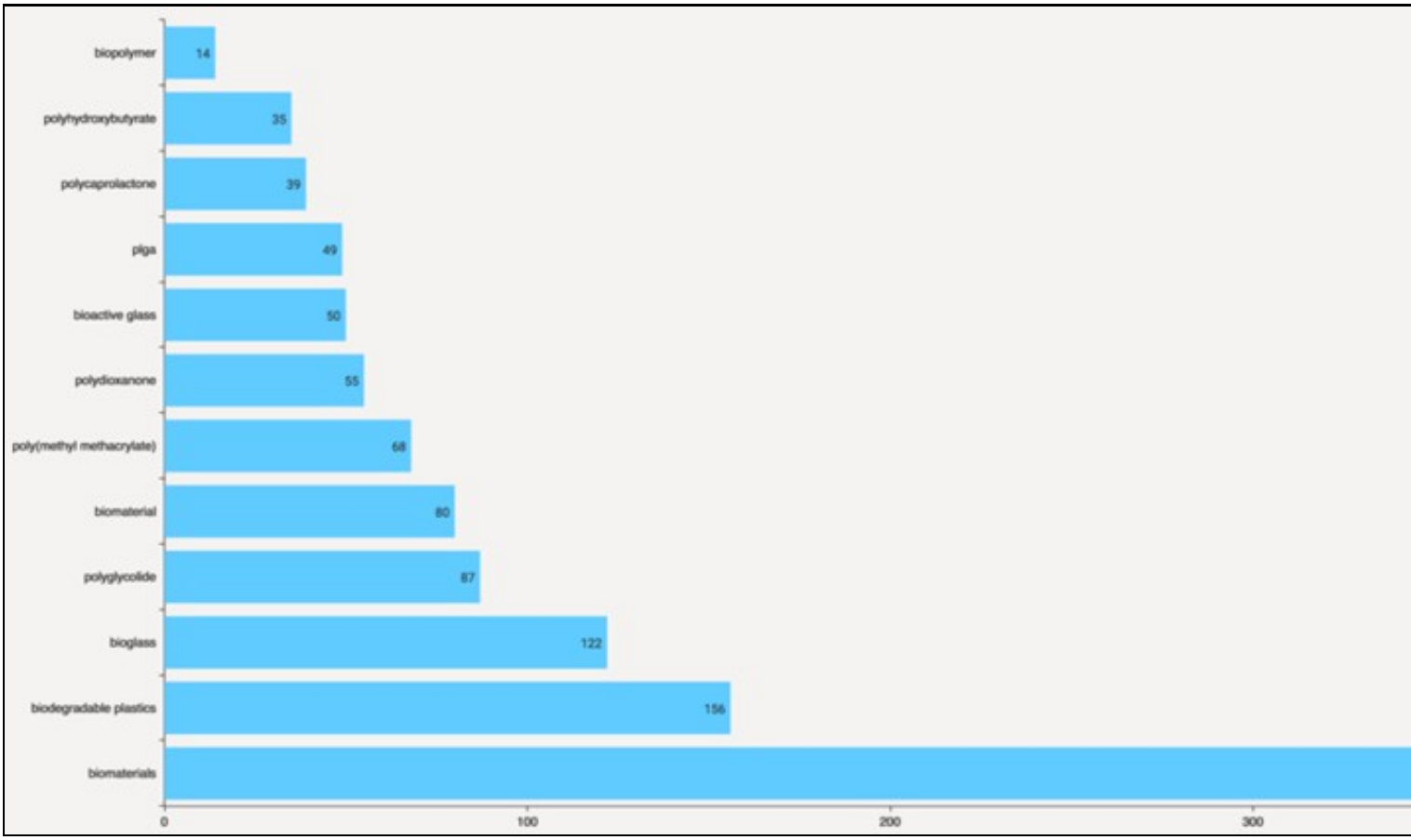


- A lot of patents mentioned **"restorative dentistry"** as the top concept. Other materials formed a big part of patent disclosures as:
    - ♦ Biomaterials & biodegradable polymers
    - ♦ Structural proteins- collagens & integrins
    - ♦ Glass compositions
- Various growth factors:
    - ♦ Bone morphogenetic proteins
    - ♦ Transforming growth factor ? (tgfb)
    - ♦ Platelet-derived growth factor
    - ♦ Fibroblast growth factor
    - ♦ Growth differentiation factor

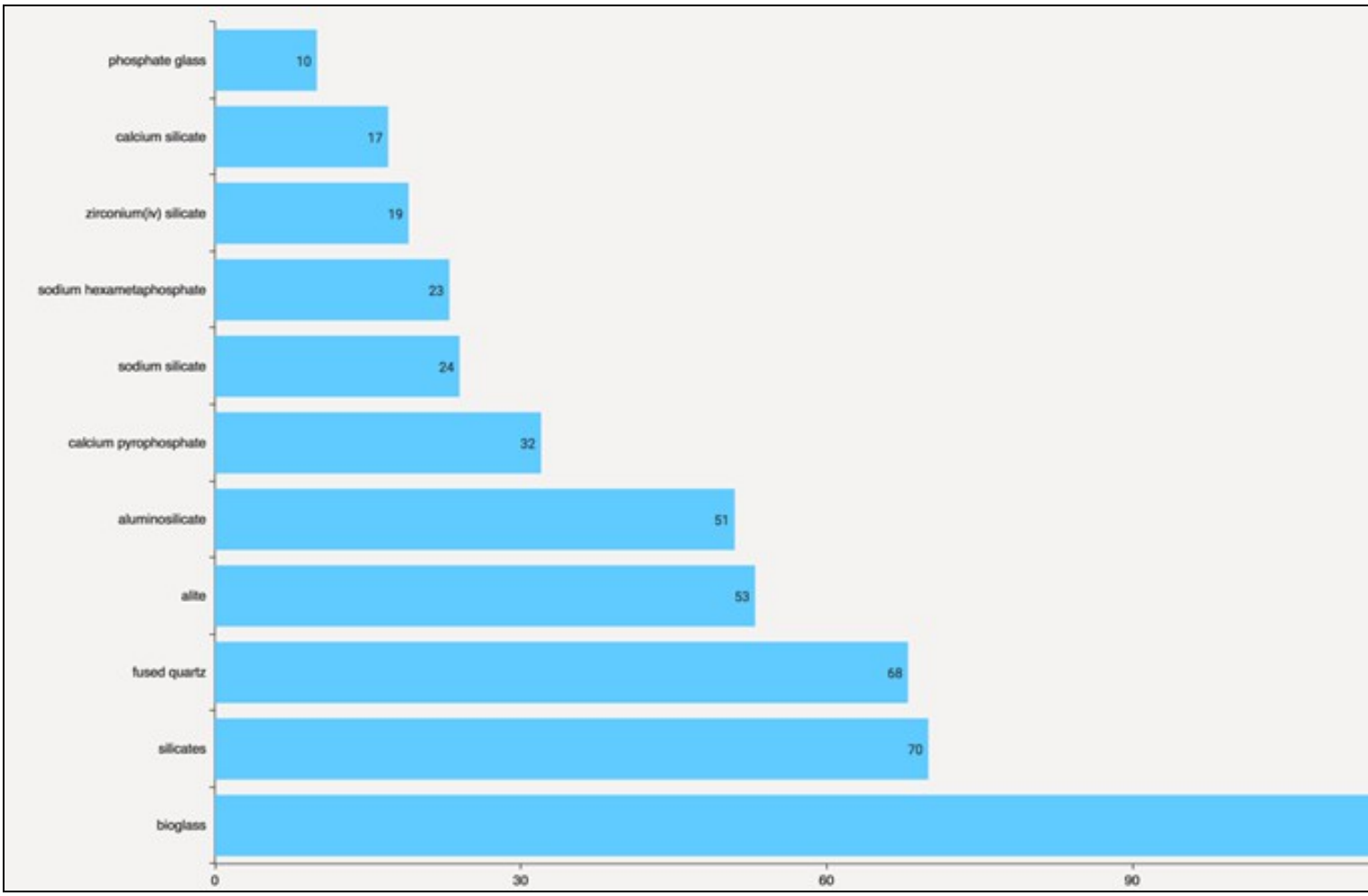
Categories and Concept in Detail



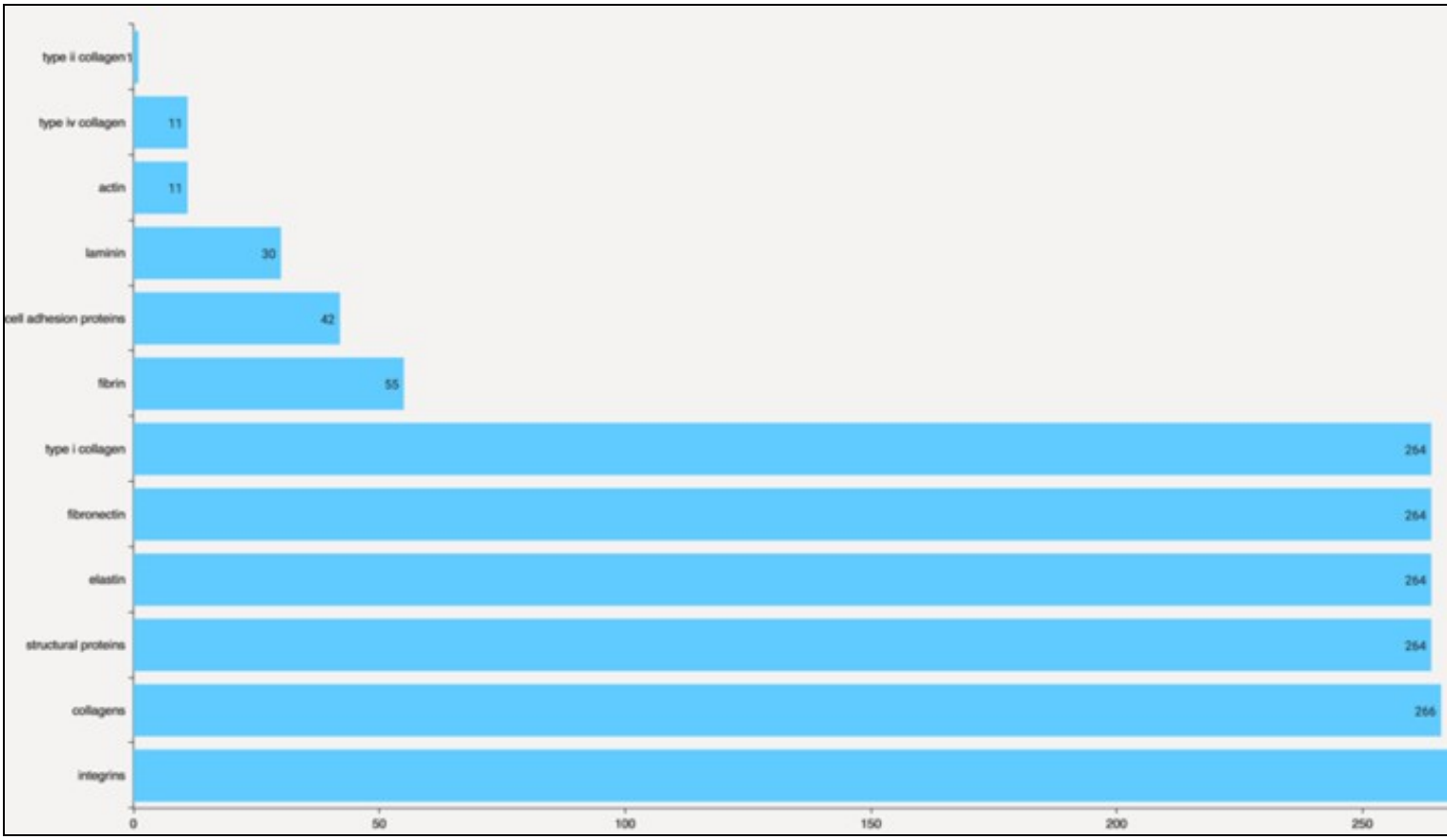
Procedures and treatments: Osseo integrations, allotransplantation, bone grafting and guided bone & tissue regeneration



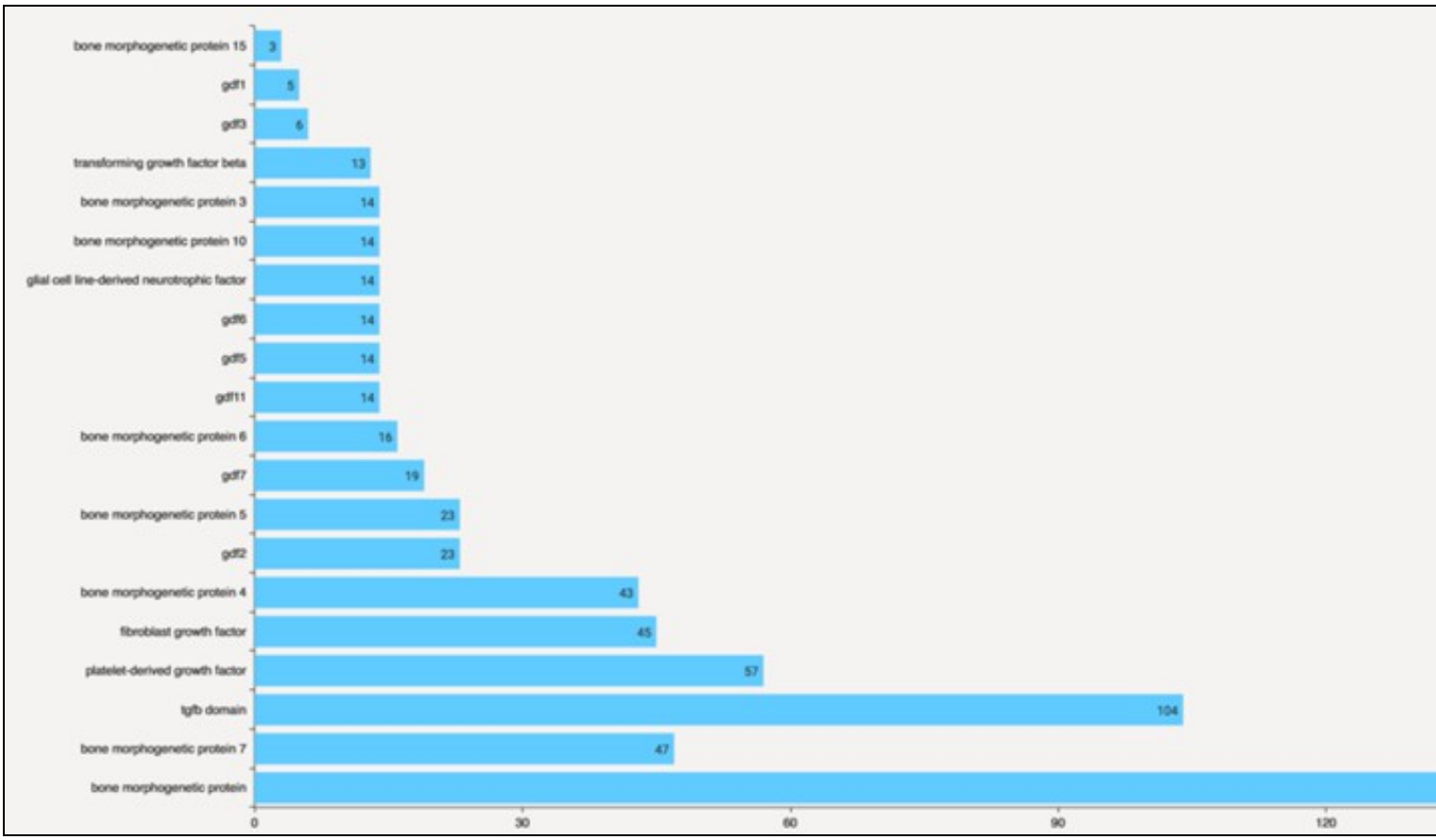
Biomaterials: biodegradable polymers, polyglycolide, poly(methyl-methacrylate), polycaprolactone, polyhydroxybutyrate



Glass, silicates, other inorganic materials: bio-glass, fused quartz, alite, aluminosilicate, calcium pyrophosphate, sodium silicate, zirconium silicate and phosphate glass



Structural proteins: collagens, integrins, elastin, fibronectin, type-1 collagen, fibrin, cell adhesion proteins, laminin and actin



Growth factors: Bone morphogenetic proteins (BMP- 3, 4, 5, 6, 7, 10 and 15), Transforming growth factor ? (tgfb) Platelet-derived growth factor, Fibroblast growth factor, Growth differentiation factor

Materials and Assignees



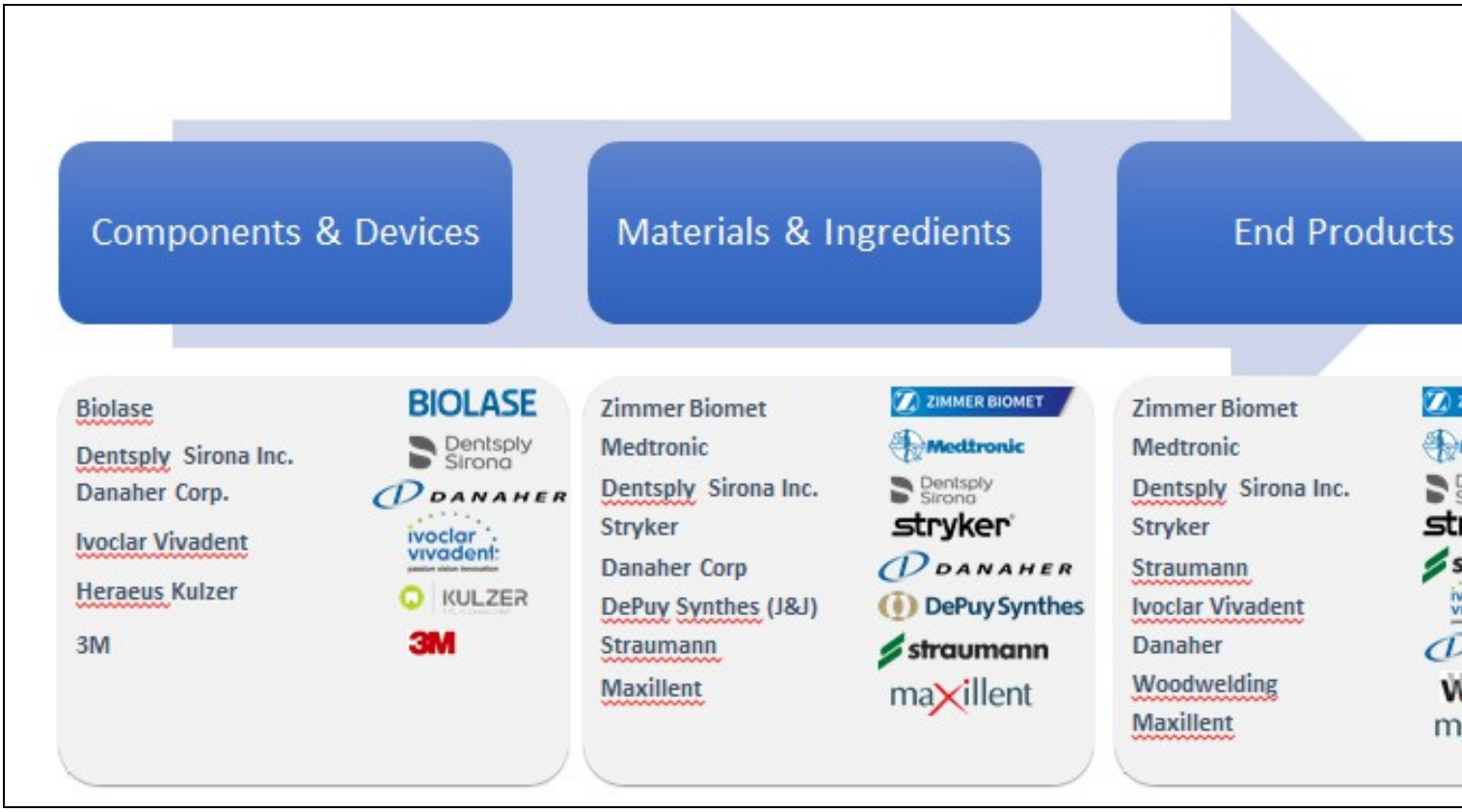
- Zimmer Biomet, Medtronics, Dentsply have patents in almost all the categories listed.
- Bayer patents are structural proteins- collagens & integrins and biomaterials
- Patents in the area of biodegradable polymers are majorly from Medtronics, Zimmer Biomet and Woodwelding
- Patents for glass composition come from Danaher, Dentsply, Medtronics, Zimmer Biomet and Straumann

Biological Growth Factors and Assignees



- Medtronics has patents in all categories listed in the graph and only one with patents for stem cells
- Platelet derived growth factor patents are majorly from Dentsply Sirona
- Zimmer Biomet and Straumann patents disclose bone morphogenetic proteins and transforming growth factors

Value Chain Analysis



Latest M&A/Collaborative activity in the space

- DePuy Synthes Products, Inc. (J&J Family of Companies), has acquired 3D printing technology from Tissue Regeneration Systems, Inc. to create patient-specific, bioresorbable implants with a unique mineral coating to support bone healing in patients with orthopaedic and craniomaxillofacial deformities and injuries. [DePuy Synthes]
- Ivoclar Vivadent has acquired equity interest in the Swiss startup company Kapanu AG. The company specializes in the application of augmented reality technology for esthetic and restorative dentistry. [Ivoclar Vivadent]
- Dentsply Sirona has announced acquisition of RTD (Recherches Techniques Dentaires), a privately held French company. The acquisition will complement Dentsply Sirona?s endodontic and restorative portfolios. [Dentsply Sirona]
- Dentsply Sirona and Kuraray Noritake Dental have announced partnership that allows Dentsply Sirona to supply its CEREC and inLab customers with expanded range of composites and validated milling strategies for multi-layered zirconia discs from Kuraray Noritake Dental. [Dentsply Sirona]