Central incisors with a history of past trauma are a common finding in dentistry today. Many of these incisors are endodontically treated at the time of trauma or shortly post trauma. However, failure of these teeth can occur at a later time as a result of fracture, internal resorption, external resorption, decay and other factors. Sources of trauma often include sports or automobile related accidents.

Once it has been determined that an internally resorbed tooth is failing, typically the restoration treatment plan that is both functionally and esthetically acceptable must be determined and implemented. The following is a case study involving maxillary right central incisors that had sustained trauma, were endodontically treated and functioned for a number of years. Approximately 15 to 20 years later, the teeth in each case failed due to internal resorption.

Internal resorption
Dental root resorption involves the loss of hard tissues that compose the teeth (dentin, cementum and enamel) occurs typically in the cervical region of the periodontal ligament and/or tooth pulp. These conditions may occur because of injury, inflammation or chronic infection of the pulp, periodontal conditions, orthodontic tooth mobility or tooth eruption.

Internal inflammatory resorption, the type of resorption identified in the following cases, is characterized by progressive loss of hard tissue in the tooth root. This degeneration is typically found in the cervical region, but has been observed in all areas of the root canal system. Internal resorption is generally asymptomatic and is discovered most frequently through radiographic examination. The loss of hard tissue is detected radiographically as uniform radiolucent expansion of the tooth canal. If internal root resorption is left to progress untreated, it may result in extension to the periodontal ligament through a crown or root perforation.

Immediately placed implants/ immediate provisionalization
The clinician faces a great esthetic challenge in the replacement of single anterior teeth. In the following cases of internally resorbed incisors with a poor prognosis, extraction followed by immediate placement of an implant is a desirable restorative option. The failing tooth is located in the esthetic zone, and therefore an immediate and esthetic replacement is necessary following extraction.

In the past, the non-restorable tooth was extracted and a removable partial denture (or flipper) was fabricated and placed for use during healing. After an adequate healing period, an implant was placed and buried under the gingiva and the patient continued to wear the flipper until the implant had osseointegrated and was ready to be uncovered and restored. The patient would therefore wear the removable partial denture for upwards of six to eight months.

This course of treatment often results in a less than desirable gingival architecture surrounding the final restoration. There are also clear indications that partial removable dentures are an important causative factor in the alveolar bone resorption process.

Major cosmetic concerns in the fabrication of the immediately placed provisional are the retention of the interdental papilla and prevention of alveolar bone collapse.

Research has suggested that immediate provisionalization following implantation allows for greater clinical control over the regeneration of tissue surrounding the site of extraction. This benefit offers anesthetic advantage of immediate loading of an implant with immediate provisionalization over alternative staged therapy treatment options.

Unfavorable alterations to the alveolar bone structure must be avoided using ridge preservation techniques and precautions in terms of osseous exposure. Immediate placement of the implant into fresh extraction sockets prevents the post-extraction resorption that occurs commonly with alternate forms of treatment, preserving the integrity of the alveolar ridge.

Case study No. 1
The patient is a 50-year-old healthy male who was examined in our office for a failing maxillary right central incisor. His history involves a soccer accident in 1993 that resulted in an elbow to the face with trauma to the right maxillary central incisor. Approximately one week subsequent to the accident, the patient’s tooth was treated endodontically. It eventually became discolored and grew increasingly out of alignment (Fig. 1).

Clinically, all other maxillary and mandibular teeth were in good condition. Periodontal examination revealed healthy gingival tissue. The patient was concerned that his anterior tooth would fracture unexpectedly and desired an immediate replacement.

Treatment options
Several treatment options were considered. The first was extraction of the maxillary right central incisor and fabrication and placement of a conventional fixed bridge of porcelain fused to metal or an all-ceramic system.

The second option was extraction of the tooth followed by placement of a removable partial denture. The next option was extraction, provisionalization with a removable partial denture (flipper) followed by implant placement. The final option involved wearing the flipper and, finally, restoration of the implant.

The best alternative was extraction and immediate replacement of the extracted tooth with an implant, followed by immediate loading with a nonfunctioning provisional. After adequate implant integration, a final restoration would be fabricated.

Advantages and disadvantages of all options were explained to the patient. He decided to continue treatment with an immediate implant restoration. The patient was then referred to a periodontist for further evaluation and implant consolation.

Implant evaluation
Implant examination revealed adequate bone height and width for implant placement immediately following extraction of the failing tooth. A surgical date was scheduled with the periodontist for extraction of the tooth and placement of the implant. An appointment was coordinated with our office for the patient directly following the surgical procedure for provisionalization of the implant.

Surgical protocol
The right central incisor was removed and a Nobel Replace Tapered Groovy (internal connection) 5.0 x 15 mm implant was placed.

An osseous graft of demineralized freeze-dried bone and a collagen membrane were utilized to augment the surgical site. The fixture received an emergence profile-healing abutment. See the radiograph with implant in place (Fig. 2).

Provisionalization
The patient presented in our office after the implant placement with a healing abutment in place. The healing abutment was removed. A Nobel Biocare immediate temporary abutment was placed and a provisional was fabricated.

Care was taken to contour the emergence of the provisional as to best support the gingival architecture. The plastic coping for the immediate temporary abutment was
roughened with a 56 carbide bur to enhance adherence of the integrity provisional material used.

The provisional was polished and placed on the immediate temporar-y abutment with a small amount of flowable composite to enhance retention. The provisional crown was fabricated to be completely out of occlusion and non-functional to insure the implant adequate osseo-integration time undisturbed by occlusal forces.

The provisional restoration was observed periodically during the six-month healing process to monitor gingival adaptation (Fig. 5).

Final restoration
Six-months post surgery, the patient was scheduled for placement of the final restoration. After removing the provisional crown and the immedi-ate temporary abutment, an implant impression post was placed, radiographic verification was made to assure complete seating and a final impression was taken with a poly-ether impression material.

Complex shade mapping was carefully performed to match the existing contralateral natural teeth. The provisional was then reinserted.

A Procera zirconia custom implant abutment was chosen. Zirconium implant abutments have not only been noted for their toothlike color and esthetic appeal, but for their tissue tolerability, high load strength and intrasulcular design enhancement.

The extraordinary load strength of the oxide ceramics is not compro-mised by high bending and tensile strength, and fracture and chemical resistance. Zirconium abutments are mechanically equivalent to their metal counterparts, but boast greater biological compatibility.

Results of a recent study pro-vide evidence that ceramic oxide abutments can be safely utilized in the incisor region of both the maxilla and mandible as determined by maximal bite forces in the esthetic zone.

Due to excellent restorative properties in terms of strength and color conformity, the zirconium implant abutment is becoming increasingly favored by clinicians for esthetically pleasing anterior implant restorations. A Procera zirconia crown was fabricated for this patient with Norite-ZCR porcelain (Fig. 4). At the time of insert, the provisional crown and immediate temporary abutment were removed. The Procera zirconia custom abutment was seated, the screw was hand tightened and the screw torque to 55 Ncm with the manual torque wrench.

The access was filled with a small cotton pellet and topped with a thin layer of flowable composite. The Procera zirconia crown was then seated; margins, contacts and occlusion were confirmed; and the crown was cemented in place with 3M ESPE RelyX luting cement (Fig. 5).

Case study No. 2
This patient, a healthy male in his late 50s, was examined in my office for a fractured maxillary right central incisor. The patient had foliated porcelain restorations on his upper central and upper lateral incisors that were placed several years ago.

He had a history of trauma to the anterior teeth from a sports injury and subsequent endodontic treat-ment. Recent periapical radiographs showed internal resorption in the upper incisors (Fig. 6).

The patient sustained additional trauma to the maxillary right central incisor through a fall that resulted in complete fracture of the crown (Fig. 7). The tooth was non-restorable. After reviewing the different treat-ment options, the patient decided on an immediate implant restoration. Although the maxillary left central incisor also exhibited signs of internal resorption, it was decided that treatment of that tooth would be performed later. Consideration was given to the poor gingival architec-ture that results from placing adja-cent implants in the esthetic zone.

He was then evaluated by the periodontist for the surgical placement of the immediate implant for the maxillary right central incisor.

The patient’s treatment was simi-lar to that of the patient in case study No. 1.

The right central incisor was removed and a NobelReplace Tapered Groovy (internal connection) 5 x 15 mm implant was placed. An osseous graft of demineralized freeze-dried bone was utilized to augment the surgical site. The fix-ture received an emergence profile-lingual abutment. The patient then received an immediate non-func-tioning provisional as the patient did in case No. 1.

Final restoration
After the six-month healing period, the final restoration was fabricated. In this case, a one-piece screw-through abutment made from a Nobel Biocare GoldAdapt Engaging NobelReplace (Fig. 8) was fabricated in order to obtain the correct emer-gence profile of the restoration due to the slightly lingual placement of the implant (Fig. 9).

The restoration was seated, the screw was hand tightened and then torqued to 55 Ncm with the manual torque wrench. The lingual screw access was filled with a cotton pellet and composite restoration (Fig. 10).

Conclusion
As esthetic expectations of patients and the desire for a convenient and timely treatment continue to increase, instantaneous replace-ment of failing teeth is becoming more routine.

In the cases cited above, both patients had sustained juries to their anterior teeth as young adults while engaging in sports. Each of the patients had been treated endodontically and experienced intra-oral resorption of the traumatized teeth approximately 15 years later.

Both of the patients’ careers and lifestyles demanded immedi-ate replacements that were non-removable and esthetically pleasing. The failing teeth were extracted and implants were inserted immediately and restored the same day with a non-functional loaded provisional.

Immediate placement and resto-ration of a single implant offers a highly esthetic and timely treatment option in the case of internal resorp-tion and tooth failure in the maxil-lary central incisors.

Furthermore, this treatment eliminates the need for a removable partial denture while maintaining the gingival architecture and pre-venting alveolar bone loss in the extraction site.

Acknowledgements
Custom abutments and porcelain crowns by Charles Moreno CDT, Excel Dental Studios.

Implant placement performed by Dr. Garry Bloch.

A list of references is available from the publisher.

About the authors
Susan McMahon Petruska, DMD, has served as a clinical professor in prosthodontics and operative dentistry at the Uni-versity of Pittsburgh School of Dental Medicine.

She is a guest lecturer in cos-metic dentistry at West Virginia University School of Dentistry, and lectures to dentists in the United States and Europe on tooth whitening and cosmetic dentistry. Petruska is a six-time award winner in the prestigious American Academy of Cosmetic Dentistry Smile Gallery com-petition. You may contact Dr. McMahon Petruska at:

SouthSide Works Office
2845 East Carson St.
Pittsburgh, Pa. 15205
(412) 581 3969
www.wowinsmile.com

Jessica Forestier was a sum-mer intern in Dr. Petruska’s office and is now a first year dental student at the University of North Carolina at Chapel Hill,