Classification of Molar Extraction Sites for Immediate Dental Implant Placement: Technical Note

Richard B. Smith, DDS[1]/Dennis P. Tarnow, DDS[2]

Dental implants may be successfully placed immediately into fresh extraction sockets when primary implant stability can be attained. This article presents a new classification system for molar extraction sites that describes extraction sockets based upon the bone available within the socket for stabilization of an immediately placed implant. Three categories—types A, B, and C—are employed: the type A socket, which allows for the implant to be placed completely within the septal bone, leaving no gaps between the implant and the socket walls; the type B socket, which has enough septal bone to stabilize but not completely surround the implant, leaving gaps between one or more surfaces of the implant and the socket walls; and the type C socket, which has little to no septal bone, thus requiring that the implant engage the periphery of the socket. Treatment protocols and relevant clinical examples are presented based upon the characterization of the socket according to this classification system. Int J Oral Maxillofac Implants 2013;28:911–916. doi: 10.11607/jomi.2627

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Immediate placement of dental implants into fresh extraction sockets of single-rooted teeth has been an accepted procedure since it was first reported in 1989.[1,2] Immediate placement of dental implants into molar sockets has also been presented as a successful alternative to the delayed protocol.[3–9] In fact, cumulative survival rates for immediately placed molar implants are similar to those for implants placed into healed molar extraction sites.[5] The literature reveals that an essential factor for successful immediate implant placement is initial stabilization of the implant with the apical and/or lateral bone.[2] However, in molar extraction sockets, achieving initial implant stability may be challenging as a result of the width of the alveolar socket, poor bone quality, and anatomical limitations beyond the apices of molar roots, such as the maxillary sinus and the inferior alveolar nerve. Therefore, in most cases the implant must be placed within the molar extraction socket itself.

The morphology of the molar extraction socket will determine whether adequate stability for immediate implant placement can be achieved. The septal bone of multirooted molars and the periphery of the socket of molars with fused or converging roots are the primary areas of bone available for immediate implant placement. However, some sockets do not allow for primary implant stability, which necessitates a delayed placement protocol (with or without socket grafting). A classification system for management of molar extraction sockets based upon the morphology of the septal bone and its influence on implant stability is presented here to help establish guidelines for immediate implant placement.

CLASSIFICATION OF MOLAR EXTRACTION SITES

Molar extraction sockets may be divided into three categories. A type A socket has adequate septal bone to circumferentially contain the coronal portion of the implant within the bone completely (Fig 1a). A type B socket has enough septal bone to stabilize the implant but not fully contain it (Fig 1b). A type C socket does not have enough bone within the socket to stabilize the implant without engaging the outer walls of the socket (Fig 1c).

[1]Associate Clinical Professor, Department of Prosthodontics, Columbia University College of Dental Medicine, New York, New York, USA.
[2]Clinical Professor, Department of Periodontology, and Director of Implant Education, Columbia University College of Dental Medicine, New York, New York, USA.

Correspondence to: Dr Richard Smith, Department of Prosthodontics, Columbia University College of Dental Medicine, 150 East 58th Street, Suite 3200, New York, NY 10155, USA. Fax: +212-754-7653. Email: RSmith@SDNYonline.com

Fig 1a Type A socket. The coronal portion of the implant is completely contained within the septal bone.

Fig 1b Type B socket. The implant is stabilized but not completely contained by the septal bone; a gap is present between the implant and the inner socket walls.

Fig 1c Type C socket. No septal bone is available for implant stabilization. A wide-diameter implant must engage the inner aspects of the socket walls and/or bone apical to the socket to be stable.

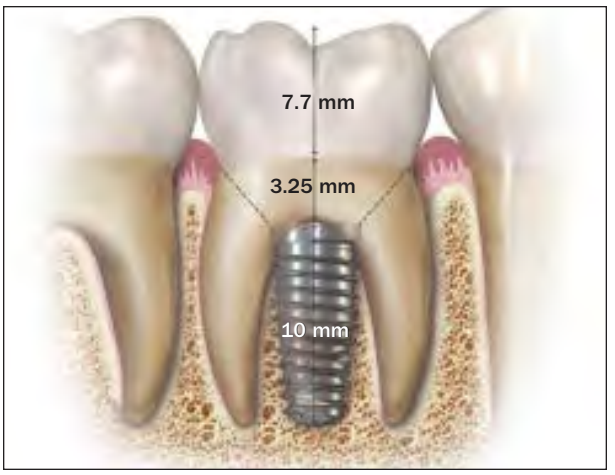


Fig 2 *(left)* Maxillary first molar sectioned prior to extraction.

Fig 3 *(right)* Implant placed in the septal bone and at the base of the root trunk/top of the furcation results in adequate running room for proper prosthetic emergence profiles.

DISCUSSION AND TREATMENT PROTOCOLS

Regardless of the root morphology or anticipated socket type, an essential tenet of the immediate placement protocol is minimally invasive, flapless extraction. Avoiding a full-thickness flap will minimize the chances of significant ridge remodeling.[10] To preserve as much septal bone as possible during the extraction procedure, molars should be sectioned first to allow elevation of the individual roots (Fig 2).

The morphology of the extraction socket is determined by the anatomy of the tooth. Therefore, proper implant positioning in three dimensions and implant stability within the socket will be influenced by the anatomy of the tooth as well. Tooth width at the cementoenamel junction (CEJ), root length, trunk length, and the degree of divergence of the roots are all elements that will determine socket morphology and, consequently, implant positioning and stability.

The vertical positioning of the immediate implant will correspond to the most coronal aspect of the septal bone at the base of the root trunk, which is defined as the portion of the root that is apical to the CEJ up to the roof of the furcation. The root length beyond the trunk (apical to the roof of the furcation) will determine the length or depth of bone available for safe implant placement—ie, to avoid anatomic "danger zones" beyond the apices (eg, inferior alveolar nerve, maxillary sinus). Tooth width at the crown portion and at the CEJ is relevant to the width of the implant platform and the depth of implant placement, as this will determine the "running room" to develop proper root/crown contours while avoiding nonhygienic ridge-lap profiles. While wider-diameter implants (6 mm or wider) may provide a predictable platform for proper root and crown emergence contours, the latter can also be achieved even with standard-diameter (4- to 5-mm) implants if the implants are placed in the proper vertical position (Fig 3). Table 1 provides the average anatomical dimensions of molar teeth.[11,12]

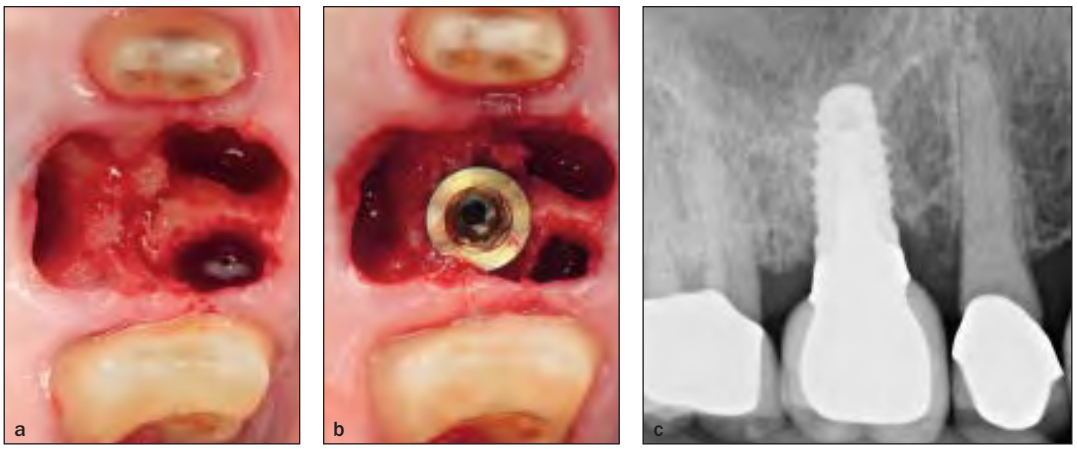
Treatment of Type A Sockets

A type A molar socket has adequate septal bone to circumferentially contain the coronal portion of the implant within the bone completely. Accordingly, the implant is placed with no gaps around it, and stabil-

Table 1 Anatomical Dimensions of Molar Teeth[11,12]

Molar	Crown width (M-D)	Root width at CEJ (M-D)	Root width at CEJ (B-L)	Root length	Trunk length	Root length – trunk length
Max first	10.4 mm	7.9 mm	10.7 mm	13 mm	4.1 mm	8.9 mm
Max second	9.8 mm	7.6 mm	10.7 mm	12.8 mm	4.2 mm	8.6 mm
Mand first	11.4 mm	9.2 mm	9.0 mm	13.5 mm	3.27 mm	10.23 mm
Mand second	10.8 mm	9.1 mm	8.8 mm	13.5 mm	3.28 mm	10.22 mm

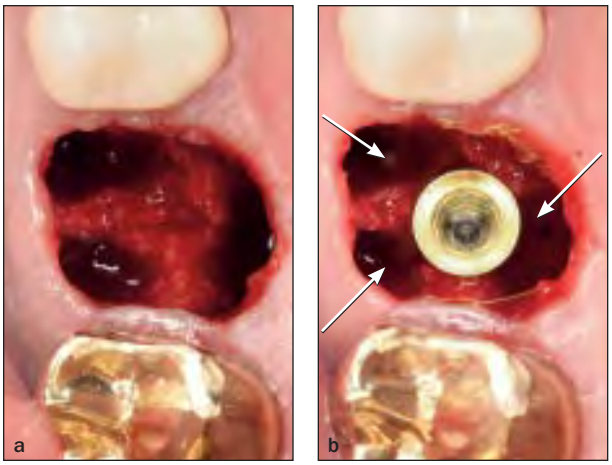
From Kerns et al[11] and Scheid and Weiss.[12]
M-D = mesiodistal; B-L = buccolingual; max = maxillary; mand = mandibular.



Figs 4a to 4c *(a)* Clinical example of a type A socket. *(b)* A 5-mm-diameter implant is completely contained within the septal bone, and the root sockets are intact. *(c)* The definitive restoration displays adequate vertical running room for proper crown contours.

ity is achieved easily (Figs 4a to 4c). If insertion torque is to be considered as an indication of stability, it is important to understand what is considered a "sufficient" insertion torque value (ITV) for implant survival. For purposes of immediate placement without immediate provisionalization, an ITV above 15 Ncm is adequate for successful integration, with an expected survival rate of 86%, which will exceed 90% if the ITV is above 30 Ncm.[13] As for the remaining root socket spaces adjacent to the septal bone, it is not necessary to graft these spaces for the implant to integrate, since bone completely surrounds the implant. However, the sockets of the buccal roots of maxillary molars may be grafted to help reduce ridge remodeling and to achieve better esthetics and prosthetic contours.[6] In terms of vertical positioning, many maxillary molar sockets have little septal bone beneath the sinus. If the implant can be adequately stabilized by the septal bone, localized osteotome sinus elevation and grafting with simultaneous implant placement can be a predictable alternative.[14]

In a type A socket that is missing some or all of its buccal bone but retains adequate septal bone for complete implant containment, an immediate implant may still be placed. If the ridge and tissue contours are, in



Figs 5a and 5b Clinical example of a maxillary type B socket. A 5-mm-diameter implant is stabilized, but not completely contained by the septal bone, such that gaps between the implant and inner socket walls are present (*arrows*).

Figs 6a to 6e *Treatment of a type B socket.*

Fig 6a Deep distal decay can be seen at the mandibular right first molar.

Fig 6b A type B mandibular first molar extraction socket, with septal bone clearly apparent.

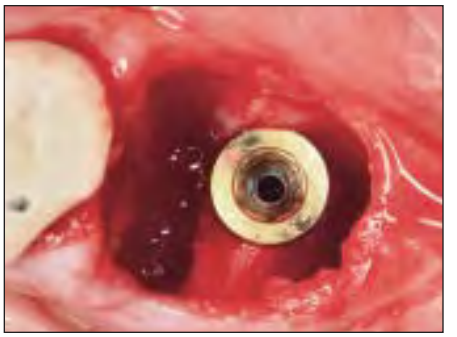


Fig 6c A 5-mm-diameter implant has been placed.

Fig 6d Intraoperative radiograph.

Figs 6e and 6f Radiograph and clinical view at 3 months postoperative, with the definitive restoration in place.

a particular case, important for enhancing esthetics or preventing food impaction, this buccal defect may be grafted at the time of implant placement, as previously mentioned.

As an alternative to septal placement, an implant may be placed directly into one of the molar root sockets, similar to an immediately placed implant in a single-rooted tooth socket. In the maxilla, the palatal root socket is often considered a good site for immediate implant placement. However, the position or angulation of the palatal root may cause the implant to be angled too far to the palatal, with the screw access hole emerging through the buccal surface of the prosthesis. Palatal positioning may also result in a crown that that is partially cantilevered, making hygiene difficult. Also, if the ridge buccal to the implant remodels horizontally and vertically, a depression that will be a food trap and/or an esthetic compromise may result. The second and perhaps more critical problem with molar root–positioned immediate implants, where the root apices are in the pneumatized sinus, is that once the remodeling of the bundle bone that lines the socket occurs, there may not be adequate volume or quality of bone remaining around the implant (adjacent to the maxillary sinus for instance), resulting in loss of implant stability and the implant itself. In mandibular molar sockets, placement of an implant in the mesial or distal root socket may result in an irregularly shaped crown with a cantilevered portion and/or a poorly positioned screw access opening, necessitating a custom or angulated abutment to redirect the opening.

Treatment of Type B Sockets

In a type B socket—in which the implant is stabilized but not fully contained by the septal bone—a gap will remain between the implant and some of the inner walls of the socket (Figs 5 and 6). With respect to the gap distance between an implant and the adjacent plate of bone, there are data that indicate that, even with primary closure, a gap of < 2 mm will fill in with bone; others have suggested that if the gap is > 2 mm and primary closure can be achieved, the site should be grafted.[15,16] In contrast, other researchers have demonstrated that implant success may be achieved, even without flap elevation, without grafting, and without primary closure.[2,17–19] If ridge architecture in a particular case is critical for esthetic or restorative reasons, grafting the gap on the buccal of an immediate implant, without primary closure, has been shown to help preserve the dimensions of the ridge.[20]

Figs 7a to 7f *Type C socket.*

Fig 7a Mandibular molar with minimal septal bone.

Fig 7b The tooth has fractured vertically.

Fig 7c A type C socket is apparent after the tooth has been removed.

Fig 7d Immediate placement of an 8-mm-wide × 9-mm-long implant.

Fig 7e Radiograph obtained at time of placement of definitive restoration.

Fig 7f The definitive restoration.

If the socket is a type B and some or all of the buccal wall is missing, a delayed placement protocol should be employed. The socket may be grafted or allowed to heal without grafting and an implant placed after sufficient bone fill has occurred. A delayed protocol without flap elevation at the time of extraction is preferable, as it allows maximum preservation of whatever buccal bone may exist, as well as an adequate zone of keratinized tissue. Socket preservation is not necessary, and after approximately 3 months of healing, a stabilized implant may be placed in the site, with simultaneous bone grafting if necessary. The mature soft tissue of the healed site will provide primary closure over a graft and membrane, which is essential for successful guided bone regeneration.

Treatment of Type C Sockets

In general, an immediate implant should engage at least 3 to 5 mm of bone apically to attain primary stability, but in molar sites this may not be possible, most often because either the inferior alveolar nerve or the maxillary sinus is in close proximity to the apices. In type C sockets, where no septal bone exists, it may be impossible to achieve implant stability without engaging the perimeter walls of the socket. Therefore, to achieve implant stability in most type C sockets a very wide implant is required. Wider-diameter implants (7 to 9 mm) that more closely approximate the width of a molar extraction socket are available for this purpose (Figs 7a to 7f).

The average buccolingual width of a mandibular second molar, the most common site for a type C socket, is 9 mm.[12] As with any extraction socket, the thickness of the buccal plate is an important indicator of the potential for recession following extraction, with thicker bone being less apt to resorb. The average thickness of the buccal plates adjacent to the mesial and distal roots of mandibular second molars—again, a common site for type C sockets—is greater than 1 mm 45% of the time.[21] However, on closer examination, it can be seen that both the buccal and lingual walls of the socket shown in Fig 7 exhibit a thickened area of bone corresponding to the furcation region between the mesial and distal root surfaces. This results in more of an hourglass shape to the socket, allowing an implant between 6 and 9 mm wide to engage the buccal and lingual walls at their thickest points (Figs 7c and 7d). Additionally, this thickening of the buccal and lingual walls may make significant alteration of ridge architecture less likely following extraction and implant placement (especially since no flap is elevated

Fig 8 Type C socket at the mandibular right first molar area. No buccal plate exists; therefore immediate implant placement cannot be performed, and a delayed protocol is necessary.

during the procedures). If some or all of the buccal wall is missing in a type C socket, the implant should not be placed, as there will be no buccal bone to stabilize the implant in the healing phase and therefore no potential for bone fill on the buccal of the implant (Fig 8).

CONCLUSION

A new classification system for molar extraction sites has been presented. This classification system helps to describe the type of extraction socket that is available to receive an implant and facilitates communication among clinicians. Based upon the characterization of sockets according to this system, treatment protocols can be recommended. Immediate implants may be placed predictably in molar sockets when initial implant stability can be attained within the septal bone, either entirely (type A socket) or partially (type B socket), or by engaging the walls at the periphery of the socket (type C socket). If, however, primary stability cannot be achieved or if the buccal plate of bone is absent and there is no septal bone to stabilize the implant, a delayed protocol should be utilized.

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