Anatomical Site Classification for Implant Insertion:ASCIi

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Statement of Problem. As a standard means of diagnostics, an orthopantomogram(OPT) permits to measure the vertical and mesiodistal dimension of available bone at the desired implant site with the help of suitable radioopaque references. Based on the clinical investigation of the dentition and the edentulous sites, information upon the width of the implant site can be obtained and documented in the dental scheme. Both findings permit together systematic primary planning for endosteal implants.

Purpose of Study. Contents of the present article are the representation of a semiquantitative classification of available bone with the aim to simplify the primary phase of a systematic implant planning.

Results. Thus the ASCIi- system permits a clear protocol of bone findings for the implant case with all information available during the primary appointment for treatment planning as a basis of further diagnostic and therapeutic measures.

Conclusion. With the ASCIi system, important parameters such as alveolar height and subcrestal alveolar width can be documented systematically, easily and time saving in the dental scheme as a basis for exact treatment planning.

Due to the variety of the morphology of different jaw segments, a uniform classification regarding the anatomical condition, i.e. spatial dimension of implant sites is a substantial problem. The frequently quoted oldest classification of absorption classes of lower jaws of Atwood refers to the symphyseal region of the mandible, thus is cannot be transferred easily to other areas[1].

The conception of Lekholm and Zarb (1985) has been based obviously on the classification described by Atwood (1973) and contains altogether five categories of different absorption degrees of the toothless upper and lower jaw. The authors discern between a) almost complete alveolous b) slight absorption of the alveolous c) advanced absorption up to the jaw basis d) slight resorption of the basal bone and e) extreme resorption of the basal bone (Fig. 1)[1,2]. The individual categories are defined on the basis of

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detailed drawings for upper and lower jaws, whereby only the anterior upper and lower jaw regions are addressed, according to the original concept of Branemark's anterior implant placement. Typical anatomical features of lateral aspects of the alveolous are not represented adequately by this classification. The degree of bone resorption is handled not quantitatively but only qualitatively with reference to basal mandibular and maxillary arches, which for practical application during implant planning appears of minor importance.

In the classification of Fallschssel the division is based on the examination of 19 skulls[3]. The classification refers only to the shape of the alveolus in the canine and in the incisor region of the edentulous maxilla. Therefore practical application is limited.

Cawood and Howell describe likewise a classification of the alveolar atrophy, which refers on an investigation of anatomical skull preparations[4]. The authors differentiate between alveolus and basal bone with respect to the different regions, they discern vertical and transversal aspects of absorption and define altogether six classes of alveolar atrophy.

The distinction between basal bones and resting alveolus is of limited interest for individual case treatment and plays a minor role for the positioning of implants. More recently Misch published a four-level classification of the bone dimension into so-called divisions A to D, whereby treatment options were confronted to the dimensions of the alveolus[5]. In category A the alveolus must have at least 5mm width. A height of 10~12mm, a length of 5mm and an angulation of the alveolus below 30 degree is required. Furthermore in the classification the crown/ implant length is considered resulting in different indications for implants or augmentative measures. Generally some problems results for the classification after Misch because different aspects are summarized in individual categories, which make an application difficult in practice. In summary we conclude that the available classifications of alveolar atrophy due to their vagueness on one hand and due to differentiation between alveolus and basal bone on the other hand do not meet sufficiently the needs of the daily clinical application for treatment planning.

DEVELOPMENT OF THE ASCII- SYSTEM

The classification suggestion carried forward in this article is based on the following premises:

1. As a basic assumption, the implant site is at the base larger than crestal. Thus, the shape in unfavorable cases is more or less acuteangled triangular, in favorable cases, a quadrangular or oviform cross-section of implant sites with a multiplicity of individual variations results.
2. The vertical dimension of implant sites can be determined with appropriate accuracy from the orthopantomogram[6,7].
3. The width of implant sites is measured with clinical procedures easily (by direct measurement and probing of gingiva width).
4. Implant sites can be judged according to the dental scheme site by site.
5. A minimum length of 10mm of an implant is assumed admitting that implants with smaller length indicate higher failure rates[8].
6. Based on an epidemiological investigation it is known, that the mean implant site dimension of edentulous alveolar segments ranges between 3,8mm (female, posterior maxillary sites) and 26.8mm (male, anterior mandibular sites)[9].
7. According to Misch for transversal rotationally symmetric implants a minimum 5mm site dimension is required[5].

Based on these premises the classification of bone sites is proposed as follows:

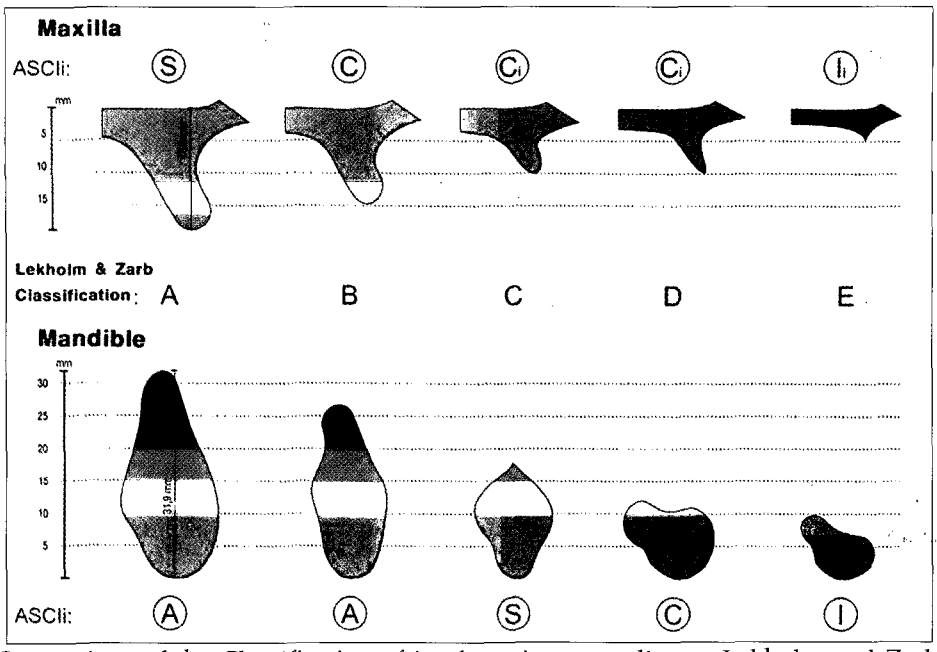

Fig. 1. Comparison of the Classification of implant sites according to Lekholm and Zarb with the ASCIi-classification presented here. Note the accordance of categories in mandibular implant sites.

1) The vertical implant site dimension is measured over the basal bone surface respectively over the roof of the mandibular canal according to the dental scheme site by site. Every site is divided basically in 4 categories:
   A: Abundant height over 20mm, identification color code blue.
   S: Sufficient height over 15mm, identification color code green.
   C: Critical height under 15mm, identification color code yellow.
   I: Insufficient height under 10mm, identification color code red(Fig. 2, 3).

2) The transversal implant site dimension is clinically determined 5mm below the bony alveolar crest site by site. It is judged to be sufficient in case of 5mm. If it falls below 5 mm, an i (insufficient width) is added to the categories ASCI.
   Thus the following categories result:

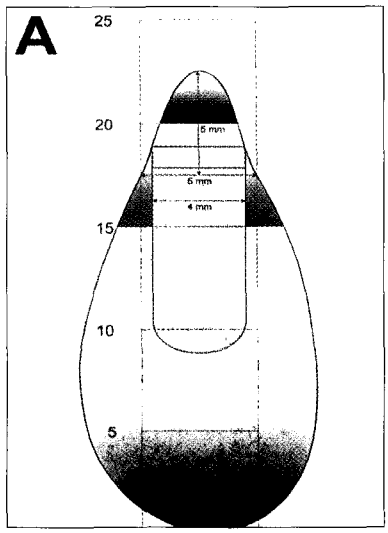

Fig. 2. Scheme of alveolar implant sites according to the ASCIi-classification. Figure represents colour codes and an example of Class A.

A: Height over 20mm, subcrestal width sufficient
Ai: Height over 20mm, subcrestal width insufficient

Fig. 3. Orthopantomogram for determination of vertical bone heights according to the ASCIi- classification. Red Columns indicate a 5mm interval for determination of a single implant site.

S: Height over 15mm, subcrestal width sufficient
Si: Height over 15mm, subcrestal width insufficient
C: Height below 15mm, subcrestal width sufficient
Ci: Height below 15mm, subcrestal width insufficient
I: Height below 10mm, subcrestal width sufficient
Ii: Height below 10mm, subcrestal width insufficient.

The findings determined according to the classifying scheme ASCIi are entered into the Dental scheme in a similar way as known for clinical dental findings. As a complementary parameter the bone density categories after Lekholm and Zarb respectively Misch and Judy can be documented site by site[2,5].

Thus the ASCIi- system permits a clear protocol of bone findings for the implant case with all information available during the primary appointment for treatment planning as a basis of further diagnostic and therapeutic measures.

DISCUSSION

A classification can work satisfactorily in clinical practice only if it is sufficiently clearly defined and easy to survey for the daily use. It must contain substantial information about the findings concerned, in order to permit a meaningful documentation and communication between the dentists participating in the treatment. Regarding the definition the ASCIi classification refers exclusive to the dimension of the anatomical implant site which can be assessed during the patients first examination.

The ASCIi-classification does not regard the difference between the jaw basis and the alveolus, which might be of interest under etiologic criteria of the alveolar reabsorption, but however of minor importance for treatment planning[2,10]. Crucial for the implantologist is the availability of bone substance independent whether it concerns the jaw basis or the alveolus.

Regarding the ASCI classification suggested by Engelke due to geometrical considerations on the one hand and more critical indication on

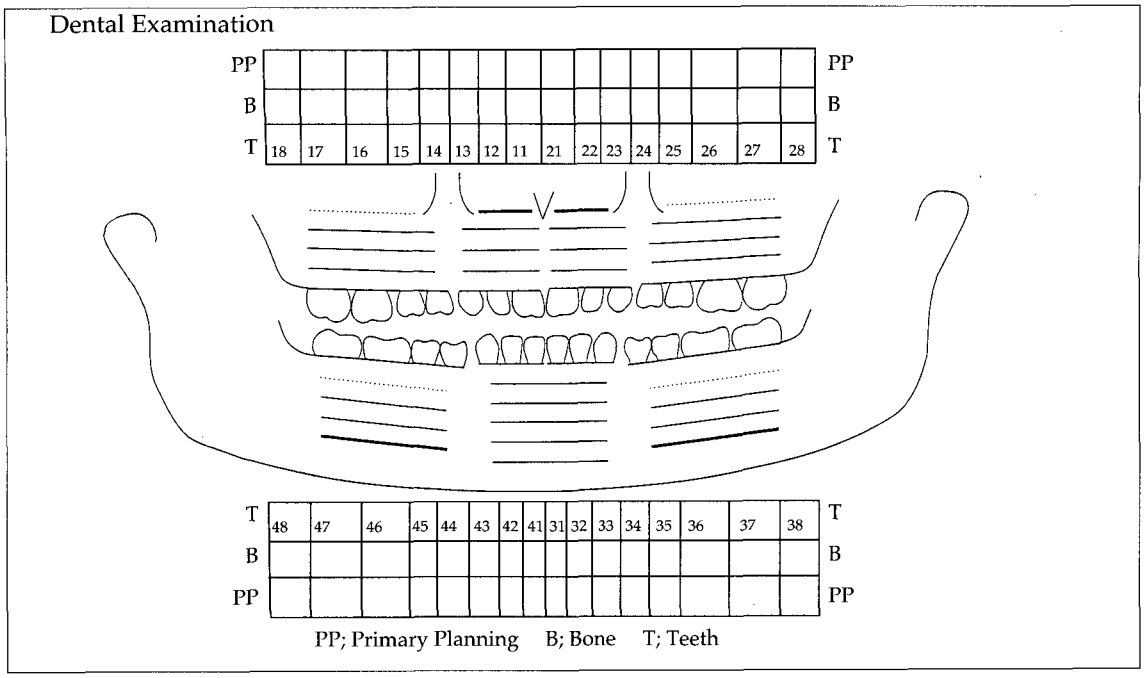

Fig. 4. Dental examination sheet for simultaneous, site specific documentation of dental findings, ASCIi-classification of implant site and primary treatment plan.

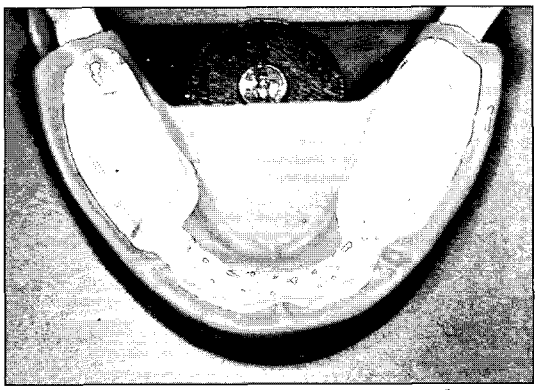

Fig. 5. The Goettingen implant training phantom, edentulous version for clinical examination of bone sites and practical education.

Fig. 6. Orthopantomogram of the Goettingen implant training phantom with titanium markers for identification of possible implant sites.

the other hand, modifications in the case of the categories insufficient (I) and critical (C) were necessary[10]. The class I (insufficient) excludes now from the beginning extreme cases of high-grade atrophy due to the vertical dimension, even if in an individual case an experienced surgeon could perform an implant insertion in bone sites of this category if necessary with help of extensive surgical means, perfect navigation technique or special implants. ASCIi is adressed primarily to implantologists to provide a safe basis of indication as prerequisite of treatment, thus in particular at

the colleagues and students in the postgraduate training as decision standard.

The application of the ASCIi classification needs some additional clarification concerning distinct anatomical conditions of implant sites. Due to the well-known triangular structure of implant sites, in the case of a category A even if a vertical reduction of the alveolus should be necessary, basically primarily stable anchorage of implants is generally possible. Reduced transversal dimensions of the sites may be compensated by local augmentative measures during primary insertion of the implant. The available implant site dimension in the maxilla is limited by the floor of the nose, the pyramid region and the maxillary sinus. In the lower jaw within the posterior area the available vertical dimension is limited by the course of the alveolar nerve, anterior to the mental foramen by the inferior margin of the lower jaw. Thus, in particular the inferior delimitation of posterior mandibular implant sites according the ASCIi-definition follows the indication for implant insertion superior to the nerve canal and does not represent the complete height of the mandible in this region. In particular within category C and I the recommendation of a 2mm vertical safety distance between the implant and the alveolar nerve is important for treatment planning.

In the interforaminal region the class I (insufficient) clearly documents that a risk of mandibular fracture occurs when trying to insert standard implants into that type of atrophic bone. Under any circumstances a category C in the anterior mandible may be misunderstood that an implantation might be still possible. However dependent on the transverse dimension and structure of the implant site an implantation in connection with augmentative procedures may be carried out. In contrast the categorie C and I in the maxilla do not include a risk of fracture, therefore the procedure for implant placement especially in anterior maxillary category Ci can be performed successfully with help of augmentative measures like alveolar reconstruction[6,7]. Generally, this category C or Ci however needs augmentation in the majority of cases. Extreme atrophy types of all regions is indicated by "I". The latter category is to be assumed automatically if the vertical bone height falls below 5mm. The clinical measurement of width then is unnecessary and would be if executed in the posterior maxillary sites misleading, since it would only give information on the extension of the maxillary sinus, and not on bone volume. The classification described was developed on the basis of an epidemiological investigation with the purpose to facilitate implantological planning exercises in pregraduate student instruction at the Georg August University Goettingen Dental School since 1996 (Fig. 4, 5, 6)[6]. It worked when applied for consultation in the implant clinic and led to the development of a systematic primary planning sheet. Further radiological-epidemiological investigations are necessary, in order to evaluate the specificity and sensitivity of the classification for the needs of implant treatment.

However it already has been proven as clinical - practical tool when primary planning implant patients in dental school routine.

CONCLUSION

With the system presented the site by site classification of bone dimension for primary implant planning is substantially simplified.

With the ASCIi system, important parameters such as alveolar height and subcrestal alveolar width can be documented systematically, easily and time saving in the dental scheme as a basis for exact treatment planning.

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