MEDICAID FUNDING FOR ORTHODONTIC TREATMENT: AAO AUTO-
QUALIFIERS COMPARED TO SALZMANN INDEX

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ABSTRACT

Objectives: Various indices exist to determine priority for orthodontic treatment need. The American Association of Orthodontists (AAO) Auto-Qualifiers (AQs) are proposed criteria to standardize treatment priority. We investigated how the AAO Auto-Qualifier criteria compares to the Salzmann Index (SI) for determining treatment need, and thus Medicaid funding for orthodontic treatment.

Methods: 81 subjects were previously screened, with completed SI scores, at Temple University Kornberg School of Dentistry (TUKSoD) between December 2019 and February 2020. Records were analyzed using the AAO Auto-Qualifier criteria. AQ results were compared to funding decisions by Insurance Company A, one of the primary Medicaid insurance companies for patients seeking treatment at TUKSoD. Malocclusion characteristics for transverse (presence of posterior crossbite), vertical (presence of open bite or deep bite) and sagittal (Class I, II, or III or presence of anterior crossbite) dimensions were recorded when funding decisions were discrepant between Insurance Company A and the AQs.

Results: Funding approval by Insurance Company A and potential approval based on the AAO AQs was found to be 37.04% and 44.44%, respectively. Funding agreement between the two assessments was 77.7% (Cohen’s kappa = 0.56). Disagreement occurred with malocclusion characteristics identified in all three dimensions, most often sagittal. Crowding or spacing ≥10mm (in either arch) and impinging overbite with evidence of occlusal contact into the opposing soft tissue were the two most common Auto-Qualifiers that resulted in funding approval. Crowding or spacing ≥10mm (in either arch) and
anterior and/or posterior crossbite of $\geq 3$ teeth per arch were the most common AAO AQs that disagreed with SI scores.

**Conclusions:** There is a moderate level of agreement for determining Medicaid funding for orthodontic treatment between Insurance Company A (based on SI scores) and the proposed AAO AQs. Adopting the proposed AAO Auto-Qualifiers nationally may result in a greater number of approvals for Medicaid funding for patients seeking orthodontic treatment in states that utilize Salzmann Index scores for determining funding decisions.
ACKNOWLEDGEMENTS

In addition to my family for their constant support in my academic pursuit, I would like to thank each committee member:

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• Dr. Sciote – Thank you for motivating and guiding me throughout my orthodontic education, particularly with understanding craniofacial growth and development as well as with this research project.

• Mr. Moore – Thank you for your enthusiasm and expertise with data analysis, a crucial component of this research project.

• Dr. Doumit – Thank you for your commitment to education and guidance in clinical orthodontics.
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CHAPTER 1
INTRODUCTION

In 1965, President Lyndon B Johnson signed the Federal Social Security Act. Title XIX of that act, known as Medicaid 1965, was created in order for medically indigent persons to be able to gain access to healthcare coverage (El-Gheriani et al. 2008). Within the act, orthodontics is included under dental care (Minick et al. 2017). A component of Medicaid, known as Early and Period Screening, Diagnosis, and Treatment Program (EPSDT), approved in 1967, mandated access of orthodontic care for Medicaid eligible patients (Minick et al. 2017). Medicaid funding would be utilized for coverage for those patients with “handicapping malocclusions,” however, there was no uniform definition of this malocclusion across states (Salzmann 1966). The direct result of this is that the need for defining and establishing criteria had become more pressing (Salzmann 1966). The Affordable Care Act, signed into law in 2010, leaves it to individual states to establish their own criteria for funding. Consequently, various indices have been used to aid in assessing the severity of malocclusions in order to help prioritize patients based on orthodontic treatment need (El-Gheriani et al. 2008).

The Handicapping Malocclusion Assessment Record (HMAR), also known as the Salzmann Index, is one of the most commonly used methods for determining insurance eligibility for Medicaid patients for orthodontic treatment. As of 2015, it is utilized by eight states, including Pennsylvania (Minick et al. 2017). It was developed by orthodontist Jacob A. Salzmann in 1967 (Salzmann 1967). It looks at specific aspects of a patient’s malocclusion and assesses severity by assigning points for various inter-arch
and intra-arch deviations to arrive at an overall numerical score (Salzmann 1967). Under the Pennsylvania Dept. of Human Services, there are specific characteristics and requirements that must be seen in order to be eligible for orthodontic treatment within the state Medicaid program. As far as the necessary score to be obtained in the Salzmann evaluation, it is required that the patient scores at least 25 points when examined by the orthodontist (Pennsylvania Department of Human Services 2018). However, because the decision is still discretionary, a score below 25 is not always denied. If there are other factors present such as tooth impactions or psychological emotional issues of the patient, for example, some states will consider this when determining whether or not a patient will be approved, though these additional considerations are not directly listed on the Salzmann Index form (Connecticut Dental Health Partnership 2015). Moreover, a score above 25 may be denied, and this is most often seen (assuming the clinician scored correctly) for patients that are still in the mixed dentition stage.

Phase I treatment, or early/interceptive treatment for children in the mixed dentition stage is somewhat of a dilemma for orthodontists when treating Medicaid patients. This is because these patients may pay for this treatment out of pocket but anticipate phase II, or comprehensive orthodontic treatment, in the future. It is possible that a patient whose malocclusion would have qualified him or her for funding has improved sufficiently enough due to Phase I treatment to go from being categorized as medically necessary to being considered elective (Jolley et al. 2010). This patient would then unlikely qualify for funding based on the Salzmann evaluation, as in fact, the Salzmann evaluation can only be completed for a patient in the permanent dentition.
Similarly, a patient in the mixed dentition may present with a malocclusion that would maintain while transitioning to the permanent dentition and be consistent with an Auto-Qualifier should he or she not receive early treatment. For example, a patient with an overjet of 9mm would auto-qualify for Medicaid funding, but if Phase I headgear treatment reduced that overjet, even slightly, and the patient presented without other major orthodontic issues, the patient would then not be eligible for funding for comprehensive treatment based on the Auto-Qualifier list.

Because there are numerous factors to consider and inconsistencies, even among states utilizing similar indices, there are disparities among patients for eligibility to receive Medicaid funding for orthodontic treatment. Salzmann recognized the importance and need for universally defined categories and criteria (Salzmann 1966). Though his index originally garnered support from the American Association of Orthodontists (AAO), in 1985, they publicly refused to endorse any specific index for assessing and determining severity of a patient’s malocclusion stating that their organization did “not recognize any index rating classification or coding system as a scientifically valid measure of the need of orthodontic treatment” (El-Gheriani et al. 2008).

Today, however, the AAO has recognized the obvious disparity that exists among Medicaid patients approved for coverage and has sought to standardize the criteria for what is considered medically necessary orthodontic treatment. Their organization has held meetings with key groups, led by the AAO Committee on Medically Necessary Orthodontic Care (MNOC) with the purpose of establishing a coalition to advocate for standardized orthodontic care (American Association of Orthodontists 2019). Their
updated definition of “Medically Necessary Orthodontic Care” is: “Orthodontic services to prevent, diagnosis, minimize, alleviate, correct, or resolve a malocclusion (including craniofacial abnormalities and traumatic or pathologic anatomic deviations) that causes pain or suffering, physical deformity, significant malfunction, aggravates a condition, or results in further injury or infirmity” (American Association of Orthodontics 2019). Therefore, in 2019, the organization put forth the AAO Auto-Qualifier (AQ) list, which includes nine clinical criteria (Figure 1). If a patient meets any one criterion, he or she would automatically qualify as a case deemed medically necessary and would thus be approved to receive Medicaid funding for orthodontic treatment. Their goal is to replace any current index of treatment need and to have this Auto-Qualifier list adopted nationwide so that there are no longer inconsistencies across states for Medicaid patients seeking funding for orthodontic care.

It is beneficial to know whether or not fewer or greater numbers of patients, and which types of malocclusions, will receive Medicaid funding for orthodontic treatment should the AAO Auto-Qualifier policy be adopted universally. Assessing how this will affect Medicaid patients seeking treatment could allow states to make an informed decision as to whether or not they would like to adopt this new policy for determining eligibility.

This study aims to determine whether or not the number of patients receiving coverage under this new AAO Auto-Qualifier policy will be increased or decreased, or remain consistent, as compared to the existing Salzmann Index. There is no prior study published that investigates the effect of the proposed AAO Auto-Qualifier criteria and
compares it to the Salzmann Index. Additionally, the study will ascertain qualitative data as to which specific malocclusions or orthodontic problems that were previously denied will now be approved (or covered), or conversely, which characteristics of malocclusions that were approved previously will now be denied. If amendments are needed to the Auto-Qualifier list, the findings of the study should help indicate what changes may be deemed necessary. Furthermore, with increased knowledge and understanding, practitioners may be able to more accurately inform their patients with confidence as to whether or not the patient can expect to be approved or denied funding for treatment.

The complete list of auto-qualifiers listed by the AAO now includes:

- Overjet: 9 mm or more.
- Reverse overjet: 3.5 mm or more.
- Anterior and/or posterior crossbite of 3 or more teeth per arch.
- Lateral or anterior open bite: 2 mm or more; of 4 or more teeth per arch.
- Impinging overbite with evidence of occlusal contact into the opposing soft tissue.
- Impactions where eruption is impeded but extraction is not indicated (excluding third molars).
- Jaws and/or dentition which are profoundly affected by a congenital or developmental disorder (craniofacial anomalies), trauma or pathology.
- Two or more Congenitally missing teeth (excluding third molars) of at least one tooth per quadrant.
- Crowding or spacing of 10 mm or more, in either the maxillary or mandibular arch (excluding 3rd molars).

**Diagnostic Records Requirement:**
- Panoramic radiograph
- Cephalometric radiograph(s)
- Intraoral and extraoral photographs

**Figure 1: Complete List of the Proposed Auto-Qualifiers and Diagnostic Records Requirement (American Association of Orthodontists 2019)**
CHAPTER 2

REVIEW OF THE LITERATURE

2.1 Motivation and Barriers to Orthodontic Treatment

Receiving orthodontic treatment has become commonplace in today’s world, and there are many different factors that motivate individuals to seek orthodontic care. In a study done in the UK, Wedrychowska-Szulc and Syrynska (2009) aimed to determine patient and parent motivation for orthodontic treatment. Questionnaires designed to assess motivation for orthodontic treatment were administered and completed by 674 subjects between the ages 7-18 years old as well as by their parents/guardians. It was found that esthetics is the principle factor for both patients and parents to undergo orthodontic treatment, and that intention to improve self-image increases with age. The decision to start treatment is often based on the dentist’s or parent’s recommendation. Interestingly, 64% of parents reported that they sought orthodontic treatment for their children out of fear of future blame if they neglected this responsibility, which falls under their role as a parent. This supports a prevailing notion that orthodontics is becoming less of an option and more of a standard in society. Health did not appear to be a key factor in undergoing treatment, however, another study found that for patients undergoing orthognathic surgery, 71% had done it for esthetic reasons but half of patients do indicate functional reasons as an important factor (Trulsson et al. 2002; Rivera et al. 2000).

Chambers and Zitterkopf (2019) administered surveys to assess motives for seeking care, perceived barriers to care, and preference of treatment by a general dentist
or orthodontist. It was found that care for children often began following a recommendation from a family dentist, and that adults decided for themselves, largely for appearance reasons. Cost was determined to be the principle barrier for seeking orthodontic care, whether it be for functional or esthetic reasons. When seeking care for functional reasons or if complications are expected, orthodontists are preferred for providing treatment. Furthermore, those of higher education and income prefer treatment by orthodontists, whereas other patient populations may favor a general dentist based on convenience or because of established relationships.

Regardless of motivation for treatment, many individuals across the nation rely on funding to be able to afford orthodontic treatment, as a primary barrier is often cost or affordability. A study by Minick and Tilliss, published in 2017, sought to better understand the disparities that exist across the United States regarding access to care by looking at Medicaid funding in the US from 2006 to 2015. Medicaid officials were contacted to attain information on age limit for treatment, practitioner type for determining eligibility and rendering treatment, records required for case review, and the rate and frequency of reimbursement. Some key findings were as follows: 1) Though the vast majority of states require services be initiated before age 21, six states since 2006 have reduced the age required for treatment initiation, 2) Only 34 states reported using indices with specific criteria for determining eligibility, whereas the number increased to 41 states by 2015, 3) In 2015, reviewer qualification must be that of an orthodontist in 18 states, 4) More states are now requiring more types of records to justify Medicaid acceptance, including additional photographs and radiographs 5) There are major
discrepancies across states as to acceptance rates in 2015, with ranges falling below 30% or above 90% depending on the state. All things considered, the study concludes that barriers to care for Medicaid-funded orthodontic treatment have been increasing and reported rates of reimbursement have decreased (Minick). Changes in reimbursement payments across various regions from 2006 to 2015 show that in most regions, rates of reimbursement have been decreasing, most dramatically in the Middle Atlantic region (Table 1).

Table 1: *Comparison of 2006 and 2015 reimbursement averages by region* (Minick 2017)

<table>
<thead>
<tr>
<th>Region</th>
<th>2015</th>
<th>2006</th>
<th>% Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>New England (CT, ME, MA, NH, RI, VT)</td>
<td>$2,719</td>
<td>$2,575</td>
<td>5%</td>
</tr>
<tr>
<td>Middle Atlantic (NJ, NY, PA)</td>
<td>$826</td>
<td>$2,336</td>
<td>−183%</td>
</tr>
<tr>
<td>South Atlantic (DE, DC, FL, GA, MD, NC, SC, VA, WV)</td>
<td>$1,973</td>
<td>$3,424</td>
<td>−74%</td>
</tr>
<tr>
<td>East South Central (AL, KY, MS, TN)</td>
<td>$1,636</td>
<td>$3,167</td>
<td>−94%</td>
</tr>
<tr>
<td>East North Central (IL, IN, MI, OH, WI)</td>
<td>$1,691</td>
<td>$3,226</td>
<td>−91%</td>
</tr>
<tr>
<td>West North Central (IA, KS, MN, NO, NE, ND, SD)</td>
<td>$2,250</td>
<td>$2,582</td>
<td>−15%</td>
</tr>
<tr>
<td>Mountain (AZ, CO, ID, MT, NV, NM, UT, WY)</td>
<td>$2,392</td>
<td>$3,162</td>
<td>−32%</td>
</tr>
<tr>
<td>West South Central (AR, LA, OK, TX)</td>
<td>$2,888</td>
<td>$2,801</td>
<td>3%</td>
</tr>
<tr>
<td>Pacific (AK, CA, HI, OR, WA)</td>
<td>$2,653</td>
<td>$3,225</td>
<td>−22%</td>
</tr>
<tr>
<td>Average</td>
<td>$2,114</td>
<td>$2,944</td>
<td>−39%</td>
</tr>
</tbody>
</table>

It is clear that there is a severe gap between motivation for treatment and barriers to care that needs to be addressed. As orthodontic treatment becomes increasingly popular and is considered a necessary standard by many, there are more hurdles to overcome before treatment may begin. The cost of receiving quality orthodontic treatment is a challenge and funding allocation by states has a direct effect on this.
2.2 Defining the Ideal Occlusion

Though there are many factors that influence an individual’s decision to pursue orthodontic treatment, it is important to have an understanding of what the accepted ideal dental occlusion looks like. Acquiring knowledge of what is considered optimal for dental function and esthetics provides clarity regarding what may be considered to be a more severe malocclusion, depending on the extent to which the occlusion deviates from what is ideal. Furthermore, the degree of severity of malocclusion is what dictates funding allocation when prioritizing patients for care.

In 1972, Dr. Lawrence F. Andrews described the characteristics of a normal occlusion (Andrews 1972). He proposed six keys of normal occlusion with the intention to supplement Angle’s molar classification for normal occlusion, recognizing the need for a more all-encompassing guideline. Angle defined a proper molar occlusion as the mesiobuccal cusp of the maxillary first permanent molar occluding with the mesiobuccal groove the mandibular first permanent molar; he described this as a Class I occlusion (Angle 1899). Andrews’ findings were made through the study of 120 cast models of patients whose teeth had never received orthodontic treatment, were straight and pleasing in appearance, had a bite that looked generally correct, and through his professional judgment, would not benefit from treatment, and thus there was no indication for it. The six keys that were put forth were as follows (Andrews 1972):

1. Molar relationship: in which the distal surface of the distobuccal cusp of the upper first permanent molar occludes with the mesial surface of the mesiobuccal cusp of the lower second molar.
2. Crown angulation, or mesiodistal tip: in which the gingival portion of the long axis of each crown was distal to the incisal portion, varying with the individual tooth type.

3. Crown inclination, or labiolingual/buccolingual inclination: in which anterior teeth (central and lateral incisors) inclination is sufficient to resist overeruption, upper posterior teeth (canines through molars) have lingual crown inclination, which is slightly more pronounced in the molars, and lower posterior have lingual crown inclination that progressively increases from canines to second molars.

4. Rotations: in which there are none.

5. Spaces: in which there are none. Contact points are tight.

6. Occlusal plane: which varies from generally flat to a slight curve of Spee.

Andrews provides visual aids including photographs and drawings with measurements to provide clarity to each key proposed.

An occlusion that possesses Andrews’ six clinical criteria is considered ideal and thus an occlusion that deviates from this ideal is known as malocclusion. A patient’s perceived severity of his or her own malocclusion may be a driving factor in their desire to pursue orthodontic treatment.

In 1899, Edward Angle, in addition to stating proper molar occlusion, classified two major types of malocclusion based on molar relationships as well, a Class II and Class III malocclusion. In a Class II malocclusion, the distobuccal cusp of the maxillary first permanent molar occludes with the mesiobuccal groove of the mandibular first
permanent molar. In a Class III malocclusion, the mandibular first permanent molar lies mesial to the maxillary first permanent molar by a premolar or cuspal width (Angle 1899).

The American Board of Orthodontics, or ABO, recognizes Edward Angle’s occlusal relationships to be ideal when finishing an orthodontic treatment. More specifically, this organization puts forth other components of occlusion that should be strived for as well in order to achieve an optimal finish (Casko et al. 1998). These components include: alignment, marginal ridges, buccolinguinal inclination, occlusal relationships, occlusal contacts, overjet, interproximal contacts, and root angulation (Casko).

### 2.3 Indices for Orthodontic Treatment Need

Reimbursement for orthodontic treatment is based on need, and this need is prioritized by assessing the severity of a patient’s malocclusion. To consistently evaluate patients, various indices have been created and have gained traction in different states since the 1960s (Grippaudo et al. 2008). Each sets a standard for what qualifies as a malocclusion of high priority for orthodontic treatment, and thus helps determine which patients receive Medicaid funding for orthodontic care.

To ensure that effective and appropriate indices were developed and utilized, the World Health Organization (WHO) put forth requirements of an ideal index in a report in 1966. This list included ten standards (World Health Organization; Grippaudo et al. 2008). For example, it emphasizes that an index should be reproducible and have internal
validity, among eight other criteria shown in Table 2. Additionally, existing indices for determining treatment need are classified as qualitative or quantitative, and correct application of an index depends on the capability of the operator. Qualitative methods use descriptions to define treatment need whereas quantitative methods apply numerical values. A list of both qualitative and quantitative indices for determining treatment need is shown in Table 3 (Grippaudo et al. 2008).

In 2015, 41 states reported using an index for determining treatment to allow states to prioritize disbursement of state and governmental funds for Medicaid patients undergoing treatment (Minick et al. 2017). Two popular indices that are used by multiple states today are the Handicapping Labiolingual Deviation Index (HLDI), a quantitative assessment developed in 1960 by Draker, and the Handicapping Malocclusion Assessment Record (HMAR), also known as the Salzmann Index, which is a quantitative assessment developed by Salzmann in 1967 (Grippaudo et al. 2008; Minick et al. 2017). The Salzmann Index is the evaluation that is utilized to determine Medicaid funding eligibility for the state of Pennsylvania, and therefore the patient population for this study. Other popular indices listed that have been used and compared in various studies include the Treatment Priority Index (TPI), a quantitative assessment developed by Grainger in 1967, as well as the Occlusal Index (OI), a quantitative assessment developed by Summers in 1967. Any index should ideally meet the requirements put forth by WHO as well as aim to accurately represent a malocclusion and prioritize it based on treatment need.
Table 2: Requirements of an Ideal Index (World Health Organization; Grippaudo 2008)

<table>
<thead>
<tr>
<th></th>
<th>Classification is expressed by a finite scale with definite upper and lower limits; running by progressive gradation from zero (absence of disease), to the ultimate point (disease in its terminal stage).</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>The index should be equally sensitive throughout the scale.</td>
</tr>
<tr>
<td>3</td>
<td>The score should correspond closely with the clinical importance of the disease stage it represents.</td>
</tr>
<tr>
<td>4</td>
<td>Index value should be amendable to statistical analysis.</td>
</tr>
<tr>
<td>5</td>
<td>The classification must be reproducible.</td>
</tr>
<tr>
<td>6</td>
<td>The index should also be simple, accurate and yield itself to modification for the collection of data.</td>
</tr>
<tr>
<td>7</td>
<td>The examination procedure should require a minimum of judgement.</td>
</tr>
<tr>
<td>8</td>
<td>The index should be simple enough to permit the study of a large population without undue cost in time or energy.</td>
</tr>
<tr>
<td>9</td>
<td>The examination required should be performed quickly, to evidence a group variation.</td>
</tr>
<tr>
<td>10</td>
<td>The index should be valid during time.</td>
</tr>
</tbody>
</table>

Table 3: Indices for Determining Orthodontic Treatment Need (Grippaudo 2008)

<table>
<thead>
<tr>
<th>INDEX</th>
<th>AUTHOR</th>
<th>YEAR</th>
<th>METHOD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Handicapping Labiolingual Deviation Index (HLDI)</td>
<td>Draker HL</td>
<td>1960</td>
<td>quantitative</td>
</tr>
<tr>
<td>Grade Index Scale for Assessment of Treatment Need (GISATN)</td>
<td>Salonen L, Mohlin B, Gotzlinger B</td>
<td>1966</td>
<td>qualitative</td>
</tr>
<tr>
<td>Dental Aesthetic Index (DAI)</td>
<td>Cons NC, Jenny J</td>
<td>1966</td>
<td>quantitative</td>
</tr>
<tr>
<td>Treatment Priority Index (TPI)</td>
<td>Grainger RM</td>
<td>1967</td>
<td>quantitative</td>
</tr>
<tr>
<td>Handicapping Malocclusion Assessment Record (HMAR)</td>
<td>Salzmann JA</td>
<td>1968</td>
<td>quantitative</td>
</tr>
<tr>
<td>Occlusal index (OI)</td>
<td>Summers CJ</td>
<td>1971</td>
<td>quantitative</td>
</tr>
<tr>
<td>Eismann index</td>
<td>Eismann D.</td>
<td>1974</td>
<td>quantitative</td>
</tr>
<tr>
<td>Index of Orthodontic Treatment Need (IOTN)</td>
<td>Brook PH, Shaw WC</td>
<td>1989</td>
<td>quantitative</td>
</tr>
<tr>
<td>Risk of Malocclusion Assessment Index (ROMA index)</td>
<td>Grippaudo C, Russo E, Marchionni P, Deli R</td>
<td>1998</td>
<td>quantitative</td>
</tr>
<tr>
<td>Memorandum of Orthodontic Screening and Indications for Orthodontic Treatment</td>
<td>Danish National Board of Health</td>
<td>1990</td>
<td>qualitative</td>
</tr>
<tr>
<td>Need for Orthodontic Treatment Index (NOTI)</td>
<td>Espeland LV, Ivarson K, Stenvik</td>
<td>1992</td>
<td>quantitative</td>
</tr>
</tbody>
</table>
2.4 The Salzmann Index: Instructions and Scoring

Pennsylvania and seven other states utilize the Salzmann Index for evaluating severity of malocclusions in order to determine eligibility for Medicaid funding for orthodontic treatment. Scores of 25 or higher qualify a patient to receive funding, and this score is calculated by summing point values for each deviation from normal across multiple categories. The Salzmann Index evaluation form is shown in Figure 2.

In 1967, Salzmann described how to utilize his index when clinically evaluating patients. Each patient is examined for intra-arch and inter-arch deviations in both the anterior and posterior segments. Intra-arch deviations account for missing, crowded, and rotated teeth as well as spacing. Inter-arch deviations account for overjet, overbite, crossbite, and open bite for the anterior segment. For the posterior segment, it evaluates crossbite, open bite, and the mesiodistal relationship between the mandibular and maxillary canine through first molar. Instructions to clinicians are as follows (Salzmann 1967):

Score: 2 points for each maxillary anterior tooth affected

Score: 1 point for each mandibular incisor and all posterior teeth affected

1. Missing teeth: Count the teeth. Remaining roots of teeth are scored as missing.

2. Crowding: Not sufficient space to align a tooth without moving other teeth in the same arch.

3. Rotation: One or both proximal surfaces are to be seen in anterior teeth. All or part of the buccal or lingual surface in posterior teeth turned to a proximal
surface of an adjacent tooth. The space for tooth alignment is sufficient in rotated teeth for their alignment.

4. **Spacing:** Score teeth, not spacing.
   a. **Open spacing.** One or both interproximal tooth surfaces and adjacent papillae are visible in an anterior tooth; both interproximal surfaces and papillae are visible in a posterior tooth.
   b. **Closed spacing.** Space is not sufficient to permit eruption of a tooth that is partially erupted.

5. **Overjet:** The mandibular incisors occlude on or over the maxillary mucosa in back of the maxillary incisors. The incisor crowns show labial axial inclination.

6. **Overbite:** Maxillary incisors occlude on or opposite labial gingival mucosa of the mandibular incisor teeth.

7. **Crossbite:** Maxillary incisors occlude lingual to mandibular incisors. Posterior teeth occlude entirely out of occlusal contact.

8. **Open bite:** Teeth occlude above opposing incisal edges and above opposing surfaces of posterior teeth.

9. **Mesiodistal deviations:** Relate mandibular to opposing maxillary teeth by full cusp for molars; buccal cusps of premolars and canines occlude mesial or distal to accepted normal interdental area of maxillary premolars.

Visual depictions to supplement each instruction are also provided in his publication to allow for greatest clarity for the clinician, in order to most accurately
evaluate. Each deviation recorded is marked and summated to arrive at the grand total numerical score.

![ORTHODONTIC SERVICE
SALZMANN EVALUATION INDEX](image)

<table>
<thead>
<tr>
<th>PATIENT'S NAME – LAST, FIRST, MIDDLE INITIAL</th>
<th>Member #</th>
<th>Date of Birth</th>
</tr>
</thead>
<tbody>
<tr>
<td>REFERRING DENTIST</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ORTHODONTIST'S NAME</td>
<td>Tax ID</td>
<td>DATE OF ASSESSMENT</td>
</tr>
</tbody>
</table>

**HANDICAPPING MALOCCLUSION ASSESSMENT RECORD**

**A. Intra-Arch Deviation**

<table>
<thead>
<tr>
<th>SCORE TEETH AFFECTED ONLY</th>
<th>MISSING</th>
<th>CROWDED</th>
<th>ROTATED</th>
<th>SPACING</th>
<th>NO.</th>
<th>POINT VALUE</th>
<th>SCORE</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAXILLA</td>
<td>ANT.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>POST.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X1</td>
<td></td>
</tr>
<tr>
<td>MANDIBLE</td>
<td>ANT.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>POST.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X1</td>
<td></td>
</tr>
</tbody>
</table>

ANT = Anterior Teeth (4 incisors)
POST = Posterior Teeth (include canines, premolars and first molars)
NO. = Number of teeth affected

**TOTAL SCORE**

**B. Inter-Arch Deviation**

1. Anterior Segment

<table>
<thead>
<tr>
<th>SCORE MAXILLARY TEETH AFFECTED ONLY EXCEPT OVERBITE*</th>
<th>OVERJET</th>
<th>OVERBITE</th>
<th>CROSSBITE</th>
<th>OPENBITE</th>
<th>NO.</th>
<th>POINT VALUE</th>
<th>SCORE</th>
</tr>
</thead>
</table>

*Score Maxillary or Mandibular Incisors
No. = Number of teeth affected

**TOTAL SCORE**

2. Posterior Segment

<table>
<thead>
<tr>
<th>SCORE AFFECTED TEETH ONLY</th>
<th>RELATE MANDIBULAR TO</th>
<th>MAXILLARY TEETH</th>
<th>SCORE AFFECTED ONLY</th>
<th>MAXILLARY TEETH</th>
<th>NO.</th>
<th>POINT VALUE</th>
<th>SCORE</th>
</tr>
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<tbody>
<tr>
<td>CANINE</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X1</td>
<td></td>
</tr>
<tr>
<td>1ST PREMOLAR</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>X1</td>
<td></td>
</tr>
<tr>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>X1</td>
<td></td>
</tr>
<tr>
<td>1ST MOLAR</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X1</td>
<td></td>
</tr>
</tbody>
</table>

**TOTAL SCORE**

**GRAND TOTAL**

Figure 2: The Handicapping Malocclusion Assessment Record (Salzmann Index) (updated from Salzmann 1968)
2.4.1 The Reliability of the Salzmann Index

It is important to assess the reliability of the Salzmann Index because funding allocation for Medicaid patients in Pennsylvania is dependent upon its outcome. Two key features to consider for any index are its reproducibility and validity: that one or more operators would get the same result for a clinical case and that it is measuring what it is projected to measure (Grippaudo et al. 2008). Because the Handicapping Malocclusion Assessment Record (HMAR), or Salzmann Index, is a quantitative index, it has an inherently lower risk for the introduction of bias as compared to qualitative methods of assessment (Grippaudo et al. 2008).

Lindauer and Thresher (1998) evaluated orthodontic treatment priority based on the Salzmann evaluation as compared to the Index of Orthodontic Treatment Need (IOTN). The records of 40 patients that were previously submitted for Medicaid funding approval were evaluated for the two indices and comparisons were made between state Medicaid and study examiner Salzmann scores, rankings, and funding decisions. A high correlation was found between state and study examiner’s Salzmann scores for clinical cases, demonstrating its high reproducibility, whereas a weaker relationship was found for IOTN. It was also determined that agreement on funding decisions were greater between the two Salzmann evaluations than when comparing the Salzmann to the IOTN. Finally, the study concluded that because each method is a unique assessment, different patients were identified for treatment approval based on the characteristics related to the criteria defined for each method.
Grewe and Hagan (1972) evaluated the precision, or chance or error and bias for the Handicapping Malocclusion Assessment Record, Occlusal Index (OI) and Treatment Priority Index (TPI). This was accomplished through analysis of inter and intra-examiner variability and as well as inter and intra-index variability. This incorporated the assessment of 130 study models from pre-treatment records of patients between 11 and 15 years of age at the University of Iowa College of Dentistry. In regards to intra and inter-examiner variability of objective examiners, all were found to be significant at the .05 level based on the Pearson’s product-moment coefficient, indicating a high degree of reproducibility for a single examiner as well as between examiners. Looking at intra-index variability, overjet and tooth displacement were found to be subjective in nature for the HMAR, whereas correlations were found to be higher for overjet than tooth displacement for the OI and TPI. For inter-index variability, significance was found at the .05 level based on Spearman rank correlation coefficients for each index, demonstrating a high degree of variance between examiners. The study concludes that no one index is better in regards to precision or intra and inter-examiner differences but indicates that the Occlusal Index has the lowest risk of bias.

Otuyemi and Noar (1996) evaluated the Handicapping Malocclusion Assessment Record, Occlusal Index, and Dental Aesthetic Index (DAI) for reliability and inter-index correlation. Pre-treatment records from 30 patients were evaluated based on each index of treatment need. When compared to the DAI, it was found that the HMAR and OI were significantly slower and more time consuming to carry out. In regards to inter-index variability, the highest correlation was between HMAR and OI, due to their similar
criteria for assessment. All indices correlated well with each other, with a p value < .0001, and high levels of reliability were found for all three indices, though the DAI was suggested to be the simplest to use.

Younis and Vig (1997) compared the reliability and validity of three indices in predicting the opinion of treatment need by a panel of 18 orthodontists. The study used 160 casts of various malocclusions that were evaluated based on the Handicapping Malocclusion Assessment Record, Handicapping Labio-lingual Deviations Index (HLD) and Index of Orthodontic Treatment Need (IOTN). Accuracy or validity was calculated by comparing to the mean opinion of orthodontic raters, used as the “gold standard.” It was found that all three indices provide valuable information for orthodontic treatment need. Diagnostic accuracy for each were similar with HMAR calculated to be 96.6%, demonstrating how accurately it reflects expert opinion.

Today, there is still no universally accepted assessment for recording malocclusion in order to determine treatment need. Many indices exist, each with strengths, but also with limitations and shortcomings. This indicates a possible need for refinement of current indices or development of an index that can be utilized nationally. This is why the American Association of Orthodontists has developed the Auto-Qualifier criteria, which aims to replace the various assessments that exist country-wide.
CHAPTER 3

AIMS OF THE INVESTIGATION

Specific Aims:

The purpose of this retrospective study is to evaluate how the AAO Auto-Qualifier criteria could affect Medicaid patients seeking coverage in states under Salzman Index determinations.

Significance:

The significance of this study is to determine whether or not fewer or a greater number of patients, in states that currently utilize the Salzmann Index, will be eligible for Medicaid funding if the AAO Auto-Qualifiers are adopted nationally. There may be certain patient populations with specific malocclusions that will be ineligible for Medicaid funding for orthodontic treatment due to a shift in the criteria to determine treatment need. The results of this study may allow states to more readily adopt or reject the AAO Auto-Qualifier proposal or may suggest possible amendments of the policy before nationwide acceptance.
CHAPTER 4

MATERIALS AND METHODS

The data collected and analyzed for this study were from records of Medicaid patients, enrolled with Insurance Company A, from the Department of Orthodontics at Temple University Kornberg School of Dentistry (TUKSoD). The records utilized were pre-existing, taken through routine screening protocol in order to submit for insurance as well as for clinical diagnostic and treatment planning purposes. All records are located in Dolphin Imaging software program, which is a 2D/3D imaging, diagnostic, practice management and patient education software (Patterson Dental Supply, Inc). Live intra-oral scans via Itero Element scanning were taken upon initial screening and downloaded into OrthoCAD, from which the scans could be visualized and uploaded into Dolphin. Digital models of patients’ dental arches and occlusion could then be assessed and manipulated; measurements could be taken directly within Dolphin Imaging. A sample digital model uploaded into Dolphin Imaging can be seen in Figure 3.

The record of each subject’s history of insurance approval or denial for treatment was obtained by checking Axium dental management software, in which all insurance decisions are recorded through standard departmental protocol. All patients were de-identified, as each patient is assigned a random number, and extra-oral photographs were not included in data collection for the study. All patients signed an informed consent, part of a standard form for treatment at Temple University, before their first visit, prior to any record-taking, to allow use of images/photographs for teaching or research purposes. Approval by the university’s institutional review board was obtained in May 2020.
4.1 Inclusion and Exclusion Criteria

The inclusion criteria for this study were as follows: Medicaid patients that have been screened at TUKSoD between December 2019 and February 2020 and are enrolled with Insurance Company A. The age range for the subjects included was 9 to 20 years old. For each subject, the following information was available: Salzmann Index score from the Temple University orthodontic resident completed at the time of screening and the decision as to whether or not the patient was approved or denied by Insurance Company A for treatment coverage. Subjects must present with permanent dentition, not including over-retained primary teeth, and be 21 years of age or younger. Patients older than 21 are not eligible. Subjects enrolled with Insurance Company A were chosen
because all the records needed for analysis for this study were taken on these patients as part of standard screening protocol. The following records that had been obtained and were analyzed for this study include panoramic radiographs, intra-oral photos, intra-oral scan (as described 4.1), as well as the completed Salzmann Index form for each subject. Some other insurance companies do not require the intra-oral scan to be submitted for rendering funding decisions, however the scan was needed for this study because it would not be possible to assess subjects via the Auto-Qualifiers without digital models or a clinical exam. Because this study is retrospective in nature, a clinical exam would not be possible, and thus digital models were needed.

The exclusion criteria for this study were as follows: patients of any age with incomplete records available as dictated by the inclusion criteria, patients with records that are not of diagnostic quality, patients whose intra-oral scans (virtual models) are inconsistent with intra-oral photographs. Ethnicity and gender were not taken into account as these demographics are not taken into account when rendering funding decisions.

4.2 Data Collection Protocol

115 subjects were selected retrospectively in a chronological order starting from December 2019 through February 2020. 81 of 115 subjects met the inclusion criteria. The information as to which patients were recently screened was obtained from Axium dental management software on TUKSoD computers. For each subject included, a Salzmann Index evaluation was first completed for this study, based on the subject’s pre-existing
records, to obtain an investigator Salzmann score. This score was recorded in addition to
the score that was previously obtained by a Temple University orthodontic resident at the
time of the patient’s screening visit. For each subject, Insurance Company A’s decision
as to whether or not the subject was approved or denied coverage was then recorded.

The AAO Auto-Qualifier list was reviewed and used as criteria for evaluation of
each subject’s records to determine if the patient would be approved or denied via the
AAO AQ protocol. The nine criteria (as dictated by the AAO) are as follows:

1. Overjet: 9mm or more
2. Reverse overjet: 3.5mm or more
3. Anterior and/or posterior crossbite of 3 or more teeth per arch
4. Lateral or anterior open bite: 2mm or more; of 4 or more teeth per arch
5. Impinging overbite with evidence of occlusal contact into the opposing soft tissue
6. Impactions where eruption is impeded but extraction is not indicated (excluding
   third molars)
7. Jaws and/or dentition which are profoundly affected by a congenital or
developmental disorder (craniofacial anomalies), trauma, or pathology
8. Two or more congenitally missing teeth (excluding third molars) of at least one
tooth per quadrant
9. Crowding or spacing of 10mm or more, in either the maxillary or mandibular arch
   (excluding third molars)

If any one of the nine criteria were met for the individual, it was recorded as an
approval based on the AAO AQs. If no criteria were met, it was recorded as denied.
Because a clinical exam of each subject is not possible, the scanned digital models were
needed for making specific measurements. Models taken via Itero scanning are
downloaded into OrthoCAD software and subsequently uploaded into Dolphin imaging
so that overjet measurements, as well as crowding and spacing measurements, could be
taken. An example of how overjet measurement was taken is shown in Figure 4.

For any patient whose eligibility decision was inconsistent between Insurance
Company A’s decision, based on the Salzmann Index, versus when analyzed using the
AAO Auto-Qualifier list, clinical characteristics of the malocclusion were recorded. The
clinical characteristics that were evaluated were as follows:

1. Transverse relationships
   a. unilateral posterior crossbite (defined as one or more teeth on either left or
      right side in crossbite)
   b. bilateral posterior crossbite (defined as one or more teeth on both left and
      right sides in crossbite)

2. Vertical relationships
   a. deep bite (defined as vertical overlap >3mm)
      i. Palatal impingement was also noted if present
   b. open bite (defined as absence of vertical overlap)

3. Sagittal relationships
   a. Molar relationship as defined by Angle
   b. Anterior crossbite (defined as presence of any amount of reverse overjet)

4. Arch Discrepancy
a. Crowding (mild, moderate, or severe)

b. Spacing (mild, moderate, or severe)

5. Other

a. Missing teeth

b. Impacted teeth

c. Over-retained teeth

Millimetric measurements were taken digitally through Mycadent and Dolphin Imaging to determine the level of crowding or spacing for maxillary and mandibular arches for each subject. For those characteristics that are classified as mild, moderate or severe, 1-3 mm was considered mild, 4-6 mm moderate, and ≥7 mm severe.

Figure 4: Overjet measurement, calculated with Dolphin Imaging software

4.3 Statistical Analysis

The recorded data was analyzed quantitatively to determine by what percentage that AQ accepts or denies patients for Medicaid funding as compared to Salzmann Index. Level of agreement between the two methods was calculated via Cohen’s Kappa test.
Malocclusion characteristics were recorded to determine which occlusal problems are more or less likely to be covered under AQ as compared to Salzmann Index.
CHAPTER 5

RESULTS

Out of 115 patients, enrolled with Insurance Company A, screened at Temple University Kornberg School of Dentistry between December 2019 and February 2020, 81 subjects were included in this study. The remaining 34 patients were not included in the data set because 1) records were incomplete, which means all necessary records were not taken or not found because of being improperly uploaded into Dolphin software, 2) records were inconsistent, ie models did not closely match intra-oral photos and so the discrepancy made the subject’s malocclusion unable to be classified, 3) patient was in mixed dentition; these patients are either put on recall or if treatment is recommended, expenses are normally paid out of pocket. Figure 5 shows the breakdown of the 34 excluded subjects.

Figure 5: Breakdown for Excluded Subjects
A total of 42 out of 81 subjects were approved for funding based on either Insurance Company A or the AAO AQs. Thus, 39 subjects were denied funding by both Insurance Company A and the AAO AQs. Total insurance approval by Insurance Company A was 30 out of 81 or 37.04% of subjects. Total insurance approval based on the AQ criteria was found to be 36 out of 81, or 44.44% of subjects. Of the 30 subjects approved for treatment by Insurance Company A, 93.33% had a Salzmann score $\geq 25$ based on the Salzmann scores that were submitted, whereas 80% had a Salzmann score $\geq 25$ based on the investigator’s Salzmann score. The percentage that Insurance Company A’s decision agreed with the Salzmann score submitted was 59.26%, whereas it was found that Insurance Company A agreed with the investigator’s calculated Salzmann scores 75.30% of the time.

A total of 24 subjects received an approval for funding based on both Insurance Company A’s decision in addition to the AAO Auto-Qualifiers. Table 4 shows all approved subjects, by either Insurance Company A, the AQ criteria, or both as well as the Salzmann score submitted and the Salzmann score calculated by the investigator for this study. It also shows which of the nine Auto-Qualifier criteria was met for those that were approved. It can be seen that some subjects displayed more than one Auto-Qualifier.
Table 4: Funding decisions and corresponding Salzmann scores for subjects who were approved (by one or both assessments) for Medicaid funding for orthodontic treatment

<table>
<thead>
<tr>
<th>Subject</th>
<th>Investigator Salzmann Score</th>
<th>Submitted Salzmann Score</th>
<th>Insurance Company A decision</th>
<th>AAO Auto-Qualifier Decision</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>26</td>
<td>30</td>
<td>Approve</td>
<td>Approve (#6)</td>
</tr>
<tr>
<td>2</td>
<td>17</td>
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</tr>
<tr>
<td>3</td>
<td>31</td>
<td>35</td>
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<td>Approve (#3,9)</td>
</tr>
<tr>
<td>4</td>
<td>25</td>
<td>27</td>
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<td>Approve (#5)</td>
</tr>
<tr>
<td>5</td>
<td>37</td>
<td>40</td>
<td>Approve</td>
<td>Approve (#4)</td>
</tr>
<tr>
<td>6</td>
<td>28</td>
<td>32</td>
<td>Approve</td>
<td>Approve (#3)</td>
</tr>
<tr>
<td>7</td>
<td>31</td>
<td>37</td>
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<td>Deny</td>
</tr>
<tr>
<td>8</td>
<td>19</td>
<td>38</td>
<td>Deny</td>
<td>Approve (#9)</td>
</tr>
<tr>
<td>9</td>
<td>29</td>
<td>34</td>
<td>Deny</td>
<td>Approve (#1)</td>
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<td>14</td>
<td>25</td>
<td>Deny</td>
<td>Approve (#9)</td>
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<td>40</td>
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<td>Approve (#3)</td>
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<td>45</td>
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<td>Approve (#5)</td>
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<tr>
<td>17</td>
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<td>44</td>
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<td>Approve (#1,5)</td>
</tr>
<tr>
<td>18</td>
<td>21</td>
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</tr>
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<td>19</td>
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</table>

There were 12 subjects that were approved by AAO AQs but denied by Insurance Company A. Among those 12 subjects, the most common AQs were found to be #3,
anterior and/or posterior crossbite of 3 or more teeth per arch, as well as #9, crowding or spacing of 10mm or more in either maxillary or mandibular arch (excluding 3rd molars). These were the two most common reasons for approval via AAO AQ assessment, when Salzmann scores were not high enough for approval by Insurance Company A. Figure 6 shows the breakdown of each AQ that was found among approved subjects. Among the 36 subjects that were approved based on the AAO AQ criteria, the most common Auto-Qualifier that was found was #3, anterior and/or posterior crossbite of 3 or more teeth per arch, followed by #5, impinging overbite with evidence of occlusal contact into the opposing soft tissue. Some subjects had multiple AQs that allowed for approval. AQ7—jaws and/or dentition which are profoundly affected by a congenital or development disorder (craniofacial anomalies), trauma or pathology—was not found among any subjects in this study.

Figure 6: Auto-Qualifiers found for approved subjects by AAO AQ method

Insurance Company A and the AAO AQ criteria agreed for 63 of 81 subjects, or 77.78% of the time (Cohen’s Kappa = 0.56; CI = .356 to .729, indicating a moderate level
of agreement between the two assessments. The assessments disagreed for 18 of 81 subjects. Characteristics for transverse, vertical, and sagittal relationships as well as arch discrepancy, for these patients whose decisions were not the same between the two methods, were recorded and are shown in Table 5. There 12 subjects who were denied based on Salzmann but approved via the Auto-Qualifiers, as shown in Table 5a. The remaining 6 out of 18 were approved based on Salzmann but would be denied based on the Auto-Qualifiers, as shown in Table 5b. Figure 7 displays the breakdown of transverse, vertical, and sagittal issues for the patients whose funding decisions were discrepant between the two assessments. In the sagittal dimension, some subjects demonstrate more than one classification. Figure 8 shows transverse, vertical, and sagittal findings further broken down into each discrepant group: the left side displaying patients who were approved via Salzmann but denied by Auto-Qualifier assessment and the right side displaying patients who were denied via Salzmann but approved by Auto-Qualifier assessment.
Table 5: Malocclusion characteristics for subjects whose funding decisions were discrepant (A: denied by Insurance Company A, approved via AAO AQs; B: approved by Insurance Company A, denied via AAO AQs)

A)  

<table>
<thead>
<tr>
<th>Transverse</th>
<th>Vertical</th>
<th>Sagittal</th>
<th>Arch Discrepancy</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>WNL</td>
<td>WNL</td>
<td>Class III sub L</td>
<td>Severe space U, mild space L</td>
<td></td>
</tr>
<tr>
<td>WNL</td>
<td>AOB</td>
<td>Class II sub R</td>
<td>Moderate space U, mild space L</td>
<td></td>
</tr>
<tr>
<td>WNL</td>
<td>WNL</td>
<td>WNL</td>
<td>Severe space U/L</td>
<td></td>
</tr>
<tr>
<td>WNL</td>
<td>Deep</td>
<td>Class II</td>
<td>Mild crowding L</td>
<td>Retained ULc</td>
</tr>
<tr>
<td>WNL</td>
<td>Deep</td>
<td>Class III sub L</td>
<td>Severe space U, mild crowding L</td>
<td></td>
</tr>
<tr>
<td>WNL</td>
<td>WNL</td>
<td>Class II</td>
<td>Mild space U, mild crowding L</td>
<td>Missing U5s</td>
</tr>
<tr>
<td>PCB</td>
<td>WNL</td>
<td>WNL</td>
<td>Moderate crowding U, mild crowding L</td>
<td></td>
</tr>
<tr>
<td>WNL</td>
<td>Deep</td>
<td>Class II</td>
<td>Mild crowding U, moderate crowding L</td>
<td></td>
</tr>
<tr>
<td>WNL</td>
<td>WNL</td>
<td>WNL</td>
<td>Severe crowding U/L</td>
<td></td>
</tr>
<tr>
<td>PCB</td>
<td>AOB</td>
<td>Class II R, Class III L, ACB</td>
<td>Mild crowding U</td>
<td></td>
</tr>
<tr>
<td>WNL</td>
<td>WNL</td>
<td>Class III sub R, ACB</td>
<td>Severe spacing U, mild spacing L</td>
<td>Retained LLe</td>
</tr>
<tr>
<td>PCB</td>
<td>AOB</td>
<td>Class III, ACB</td>
<td>Mild crowding U/L</td>
<td></td>
</tr>
</tbody>
</table>

B)  

<table>
<thead>
<tr>
<th>Transverse</th>
<th>Vertical</th>
<th>Sagittal</th>
<th>Arch Discrepancy</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>WNL</td>
<td>AOB</td>
<td>Class II sub L</td>
<td>Mild space U, mild crowding L</td>
<td></td>
</tr>
<tr>
<td>WNL</td>
<td>AOB</td>
<td>WNL</td>
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</tr>
<tr>
<td>WNL</td>
<td>Deep</td>
<td>Class II</td>
<td>Mild crowding U</td>
<td></td>
</tr>
<tr>
<td>PCB</td>
<td>WNL</td>
<td>Class I, ACB</td>
<td>Mild crowding U/L</td>
<td></td>
</tr>
<tr>
<td>WNL</td>
<td>WNL</td>
<td>Class II sub R</td>
<td>Mild crowding U/L</td>
<td>Missing UL1</td>
</tr>
<tr>
<td>WNL</td>
<td>Deep</td>
<td>WNL</td>
<td>Mild crowding U, moderate crowding L</td>
<td>Transposed UR2,3</td>
</tr>
</tbody>
</table>

WNL = Within Normal Limits, AOB = Anterior Open Bite, ACB = Anterior Crossbite, sub L/R = subdivision Left/Right, PCB = Posterior Crossbite, U = Upper arch, L = Lower arch, UR = Upper Right, UL = Upper left
Figure 7: Transverse, vertical, and sagittal characteristics for subjects whose funding decision was discrepant between Insurance Company A and the AAO AQ criteria
Figure 8: Transverse, vertical, and sagittal characteristics for subjects in both discrepant groups: Approved Salzmann → Denied AQ as well as Denied Salzmann → Approved AQ
CHAPTER 6

DISCUSSION

In regards to the methods of the study, patients whose records were incomplete, inconsistent, or patients in mixed dentition were excluded. It is possible, though unlikely, this could have had a small impact on the findings of this study. This is because for records that are inconsistent, when models do not match photos, this could be due to difficulty or inability of a patient to accurately reproduce his or her bite. These patients may have difficulty reproducing because of shifting or posturing of the mandible. Accurate representation of the patient’s malocclusion could be beneficial and is necessary when computing Salzmann scores or assessing via the AAO AQ criteria.

Patients with incomplete records made up the largest portion of subjects who were excluded. A few of those patients were likely lost to follow up, which is the reason not all records were taken for those subjects. This could potentially influence the findings because those patients may not have returned due to receiving low Salzmann scores. On occasion, a patient may hear from the doctor that his or her score is low and that he or she will be less likely to receive funding for treatment. If they do not want to or cannot pay for treatment out of pocket and are anticipating getting denied funding, they would possibly avoid spending additional time going further in the record-taking process. The AAO AQ criteria only has a moderate level of agreement with funding decisions from the insurance company which were based on the Salzmann scores. This means that some subjects who may not have returned due to low Salzmann scores could have still met one or more of the AAO Auto-qualifier criteria. For example, our data suggests that patients with crowding or
spacing of 10mm or more, or patients with anterior and/or posterior crossbite of 3 or more teeth may sometimes present with low Salzmann scores, but would still qualify via the AAO AQ criteria.

In regards to the Salzmann Index, another point worthy of noting is possible inconsistency among residents who complete the evaluation. Though the Salzmann Index is meant to be an objective evaluation, there is still some degree of variation between practitioners when completing it. For example, some may be more lenient when a patient is tending toward super Class I and record the patient as Class III sagittal, documented by scoring mesial relationship of mandibular posterior teeth to the maxillary posterior teeth; whereas another doctor may only score a patient this way based on clear Class III relationships as defined by Angle. For the subjects in this study, each had one doctor fill out the Salzmann Index but it was not always the same doctor. This may result in variations for scoring and influences the scores that are submitted to insurance companies.

Among all Auto-Qualifier approvals, Figure 6 shows the most common AQ for this study population to be #3, anterior and/or posterior crossbite of ≥3 teeth per arch, followed by #5, impinging overbite with evidence of occlusal contact into the opposing soft tissue. The least common, which was not seen at all, was #7—jaws and/or dentition which are profoundly affected by a congenital or developmental disorder (craniofacial anomalies), trauma or pathology. It is difficult to generalize these findings nationally to a greater population. It is possible that the patient population seen at Temple University does not necessarily represent patients seeking orthodontic treatment on a more global level.
The study also relies heavily on the fact that Pennsylvania insurance companies, such as Insurance Company A, render funding decision solely on Salzmann Index scores above 25. It is possible that there are other criteria insurance companies consider when determining funding decisions. For this study, we found that Insurance Company A approved 30 subjects for Medicaid funding for orthodontic treatment. Two of those subjects has Salzmann scores submitted below 25. Interestingly, both of those subjects had an impaction where eruption is impeded, which is the AAO AQ #6. Therefore, those subjects were approved by both assessments, though Salzmann scores were low. Thus, all subjects that met criteria for AQ #6 were approved for funding regardless of Salzmann score.

When recording malocclusion characteristics for transverse, vertical, and sagittal for patients whose funding decisions were discrepant between the two methods, it was found that most subjects were WNL in the transverse, about half were within normal limits in the vertical, and only about a quarter were WNL for sagittal relationships. It may be inferred that patients with sagittal issues are the ones in which the two methods of assessments disagree most. In contrast, it may be that patients with transverse problems are more likely to agree between the two methods and those with vertical problems may go either way. It does not appear that there is one specific population that would be negatively affected should the criteria switch from Salzmann to AQ, indicating that there may be no need for an additional Auto-Qualifier that could have been lacking. The data suggests that switching from Salzmann to Auto-Qualifiers may actually benefit some patients who are sagittal Class III.
Based on the results of the study, about one third of patients (37%) submitted for insurance approval were accepted for funding by Insurance Company A. When looking at potential approval based on AQs, this decision is closer to half of patients (44%) that are submitted for approval. Although it was found that the assessments have a moderate level of agreement, if 7% more patients are eligible for funding with the AAO AQs, this substantially increases access to care and thus the number of people are able to receive orthodontic treatment.

### 6.1 Limitations of the Study

This study only looked at Insurance Company A enrolled patients because this company requires copies of the digital models to be submitted for insurance decisions. In order to assess subjects for the AAO AQ criteria, models are needed since it is not possible to look at those patients clinically due to the retrospective nature of the study. Insurance Company B is another insurance provider that many patients at TUKSoD are enrolled with. It would have been beneficial to compare funding decisions with both insurance companies; however, digital models are not required for patients with Insurance Company B and so those subjects could not be included in this study. In addition to looking at only one insurance company, only subjects in the permanent dentition were included. The AAO does not explicitly state as to whether or not the qualifiers may apply to patients in the mixed dentition stage. If this is the case, it would be beneficial to assess the proposed criteria for those patients as well. Should these patients be eligible for funding and treated with Phase I orthodontics, a similar concern may arise in that it is possible to improve a
patient’s malocclusion enough in which he or she would not qualify later, when comprehensive (or phase II treatment) is needed.

Another limitation is that this study only compares the AAO Auto-Qualifiers with the Salzmann Index. The Salzmann Index is one of the most prevalent indices for determining treatment need but it is not utilized in every state. The goal of the AAO is to have the AAO Auto-Qualifiers adopted nationally to standardize prioritizing patients for treatment need, and thus funding allocation. The study gives insight into how this potential change would affect states that utilize the Salzmann Index; however, it does not provide insight as to how it would compare with other states that base decisions primarily using other indices of treatment need. A study with a larger sample of patients from multiple states with insurance providers that utilize various indices could be beneficial for discerning how the shift to the AAO AQs could affect patients as a whole, nation-wide.
CHAPTER 7

CONCLUSIONS

The conclusions of this study are as follows:

- There is a moderate level of agreement between the Salzmann Index and AAO Auto-Qualifiers for determining treatment need, and thus Medicaid funding decisions for orthodontic treatment.

- Auto-Qualifier #3—presence of anterior and/or posterior crossbite of 3 or more teeth per arch; and Auto-Qualifier #5—impinging overbite with evidence of occlusal contact into the opposing soft tissue were the most common AQs found that resulted in funding approval based on that method.

- Auto-Qualifier #3—presence of anterior and/or posterior crossbite of 3 or more teeth per arch; and Auto-Qualifier #9—crowding or spacing of 10mm or more, in either maxillary or mandibular arch (excluding third molars) are the two most common Auto-Qualifiers that are found for AAO AQ approval when Salzmann Index scores do not result in funding approval by Insurance Company A.

- Auto-Qualifier #6—impactions where eruption is impeded but extraction is not indicated (excluding third molars) appears to result in approval for both assessments, regardless of Salzmann scores below 25.

- It does not appear that there are patients with certain malocclusions that would be negatively affected should the criteria switch from Salzmann to AQ, indicating that there may be no need for an additional Auto-Qualifier that could have been lacking.
• Adoption of AAO Auto-Qualifiers nationally may result in a greater number of patients approved for Medicaid funding in states (such as Pennsylvania) that utilize the Salzmann Index to determine patient priority for treatment need.


Otuyemi, O., & Noar, J. Variability in recording and grading the need for orthodontic treatment using the handicapping malocclusion assessment record, occlusal index and dental aesthetic index. Community Dentistry and Oral Epidemiology. 1996. 24(3), 222-224.


APPENDIX A

PATIENT INFORMED CONSENT AND AUTHORIZATION STATEMENT

Consent and Agreement

Please read the following information carefully so that you will understand the conditions under which patients are treated at the Temple University Kornberg School of Dentistry. At the bottom of this section, place your signature indicating that you understand these conditions and that you give permission for necessary treatment, the presence of observers, and for the staff’s use of your treatment records, including photographs and audio visual recordings, for teaching purposes or for use in scientific publications.

1. Patient care in the School Clinics proceeds more slowly than in a private dental practice since treatment is rendered by students and supervised by attending faculty.

2. Screening procedures or the rendering of treatment expressly for relief of pain or discomfort do not commit the School of Dentistry to further treatment.

3. All patient records and diagnostic aids such as x-ray films are the property of the School of Dentistry.

4. Fees will be assessed for screening, diagnosis, treatment, consultation or other dental services. I understand that I am responsible for charges for the services that I receive that may include but are not limited to procedures not covered by or disallowed by my insurance, all deductibles and co-payments. I further understand that I am responsible to pay these charges at the time they are incurred.

5. Failure to keep three appointments for whatever reason could result in the discontinuation of treatment.

6. Our staff will answer any questions about this consent and agreement form that are not clear.

I hereby give consent to the Faculty of the Kornberg School of Dentistry at Temple University and the students and dental auxiliaries working under faculty supervision to perform on myself, ________ my son, ________ my daughter, ________ my ward those procedures and treatments including local anesthesia and/or conscious sedation which are deemed necessary with the exception of ________. I have been informed there are some risks inherent in all dental procedures including the administration of local anesthesia and the administration of drugs common to dental practice. I will be asked to sign a separate informed consent form for my dental treatment once I am evaluated by my dentist. I am aware that the risks are essentially the same as those procedures performed in a private dentist’s office (for example, possible allergic reaction to anesthetic or drug, possible accidental cuts or abrasions). I certify that I understand and agree to the conditions set forth above. I also understand I am free to ask any questions regarding the procedure and risk involved.

Signature of Patient, Parent or Guardian __________________________ Date ____________

Witness __________________________ Date ____________

Interpreter’s Statement: I have interpreted:
• The information and advice explained to the patient by the healthcare provider getting this consent.
• The patient’s questions to the healthcare provider.

I have done this using □ American Sign Language or by speaking in __________________ language. To the best of my knowledge, he/she understood this interpretation.

Interpreter __________________________ Date ____________

Provider Signature and Title __________________________ Date ____________

Rev. 10/2017
APPENDIX B

IRB APPROVAL

Approval for a Project Involving Human Subjects Research that Does Not Require Continuing Review

Date: 22-May-2020

Protocol Number: 26919
PI: GODEL, JEFFREY H.
Review Type: EXEMPT
Approved On: 22-May-2020
Committee: A1
School/College: DENTAL SCHOOL (0700)
Department: DENTAL:ORTHODONTICS (07160)
Sponsor: NO EXTERNAL SPONSOR
Project Title: Medicaid Funding for Orthodontic Treatment under AAO Auto-Qualifiers Compared to Salzmann Index

The IRB approved the protocol 26919.

The study was approved under Exempt or Expedited review. The IRB determined that the research does not require a continuing review, consequently there is not an IRB approval period.

If applicable to your study, you can access your IRB-approved, stamped consent document or consent script through ERA. Open the Attachments tab and open the stamped documents by clicking the Latest link next to each document. The stamped documents are labeled as such. Copies of the IRB approved stamped consent document or consent script must be used in obtaining consent.

Note that all applicable Institutional approvals must also be secured before study implementation. These approvals include, but are not limited to, Medical Radiation Committee (“MRC”); Radiation Safety Committee (“RSC”); Institutional Biosafety Committee (“IBC”); and Temple University Survey Coordinating Committee (“TUSCC”). Please visit these Committees’ websites for further information.

Finally, in conducting this research, you are obligated to submit the following:

- Amendment requests - All changes to the research must be reviewed and approved by the IRB. Changes requiring approval include, but are not limited to, changes in the design or focus of the research project, revisions to the information sheet for participants, addition of new measures or instruments, increasing the subject number, and changes to the research funding. Changes made to eliminate apparent immediate hazards to subjects and implemented prior to IRB approval must be promptly reported to the IRB.
- Reportable New Information - using the Reportable New Information e-form, report new information items such as those described in HRP - 071 Policy - Prompt Reporting Requirements to the IRB within 5 days.